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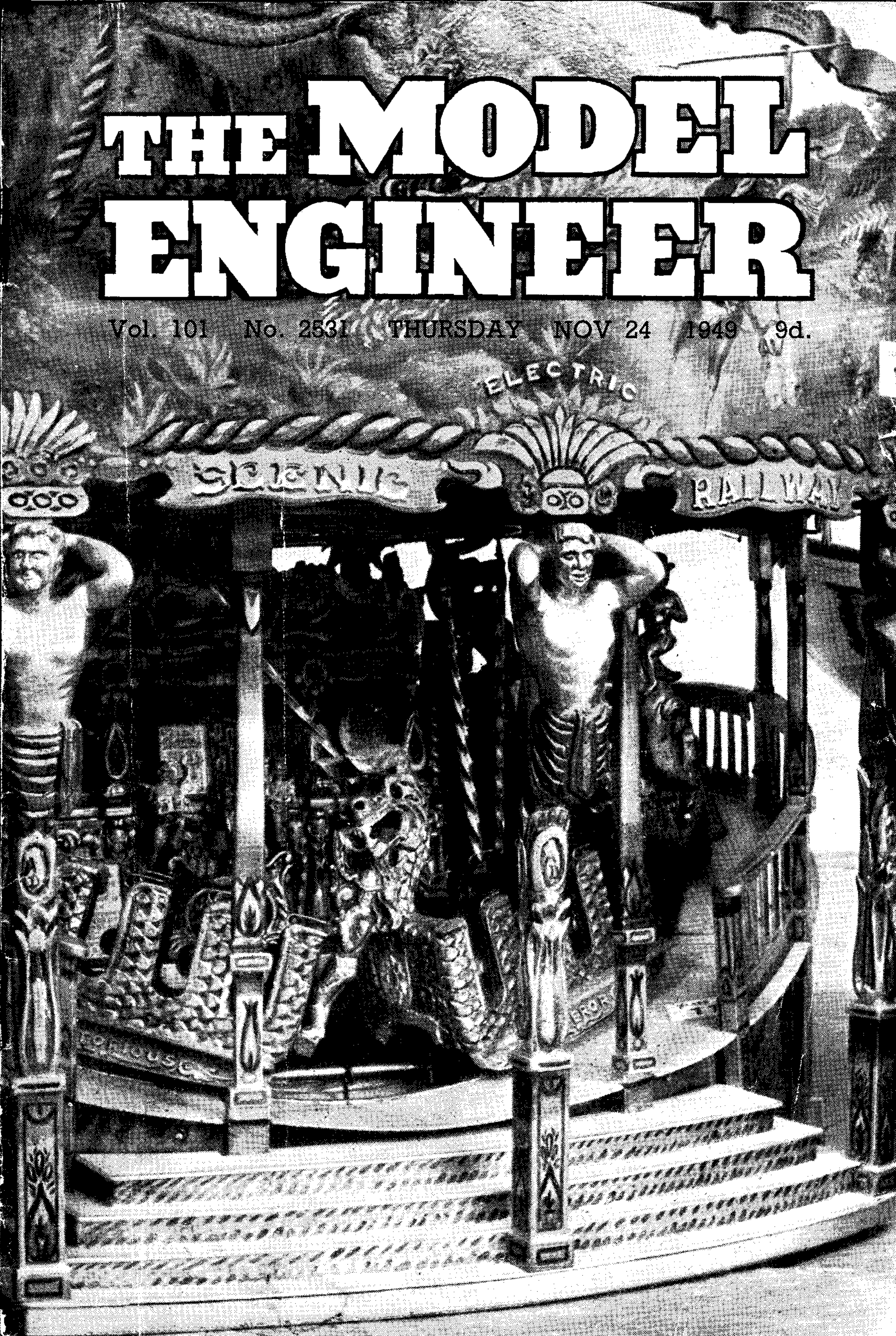


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

24TH NOVEMBER 1949 VOL. 101 NO. 2531

SMOKE RINGS

Our Cover Picture

● THE FAIRGROUND, or to give it its more modern appellation, the "amusement park," has always been a source of interest and inspiration to the model engineer, and in addition to that evergreen favourite, the showman's traction engine, many of the amusement devices are excellent subjects for working models, giving scope for the exercise not only of mechanical craftsmanship but also skill in sculpture, relief moulding, and painting. At the last "M.E." Exhibition, two outstanding models of this type appeared, one being a very fine steam-driven model of a set of three-abreast "galloping horses and cockerels," by Mr. W. Stables, of Ulverston, and the other a working model "scenic railway," by Mr. A. E. Dandridge, of Headington. The latter, which forms the subject of our cover picture, is a unique example of fidelity in detail, particularly in respect of the sculptural ornamentation and brilliant colouring of the prototype. The workmanship and finish of the model are excellent, and the constructor is to be congratulated for the successful execution of a very difficult type of model. Recent years have seen many changes in the atmosphere of the fairground; the showman's traction engine has become almost entirely obsolete, and modernistic decoration in severe outline, massed colouring, and chromium plating is gradually replacing the gilt and vivid colouring of a past decade. But few will deny the attractions of the old-time fairground, gaudy and rococo though they may have been according to modern taste; and many of our happiest youthful memories are inseparably bound up with the blare of the "orchestrion," and the glare of the arc lamps or naphtha flares.

The "M.E." Speedboat Competition

● IN REMINDING readers that this competition will be held as usual this year, we take the opportunity of pointing out that its continuance as a permanent annual event will depend upon its support by a sufficiently large number of entrants. For many years now, the competition has served a very useful purpose in the annals of model power boats, not only in recording the progress and achievements of the current year, but also by furnishing statistical data on salient features and tendencies in design. The particulars of important items such as types of hulls, diameter and pitch of propellers, engine dimensions, etc., are all helpful to those interested in the development of design, and the exponents of model power boats owe it both to themselves and other members of their fraternity to put these facts on record. No matter whether or not they qualify for the highest awards, every entrant in the competition contributes something to progress, and his efforts deserve recognition. The competition is open to all entrants in the British Isles, either club members or lone hands being equally eligible, and any run made during the year will be accepted for entry if duly authen-

ticated by timekeepers as specified in the rules. Both the hull and power plant of the boat must be built by the competitor. Silver and bronze medals, and certificates of merit are awarded in all classes, and separate awards are made for steam and i.c. engine-propelled boats. Entry forms, containing particulars of the competition rules, are obtainable free of charge from this office, and the closing date for entries is December 31st.

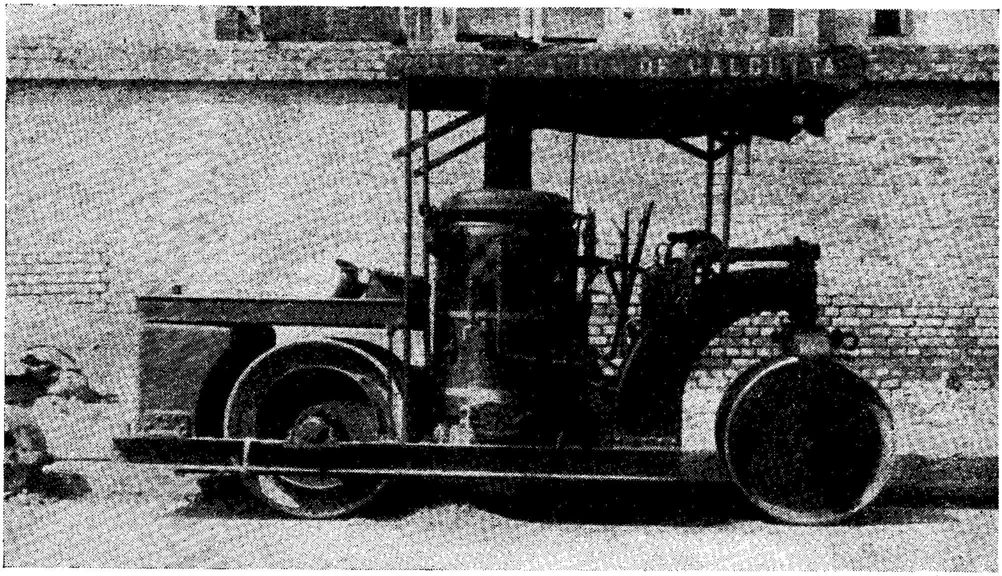
The Craftsmanship That Was

● WE CONTINUE to receive many requests for drawings of this or that particular make of traction engine, though such requests, of late, have been for makes which are not already included in our present range of these drawings. We think that a few comments on the subject may not be amiss and we hope they may be of interest.

First, it is due entirely to the prevailing demand that we have been at some pains, during the last few years, to try to help enthusiasts to obtain the required information. Our steadily, if slowly, growing list of traction engine drawings is one result; recent and coming articles make up another, and there are some books in course of preparation for adding still more information.

There must be many enthusiasts, however, who wonder why there is, apparently, so much difficulty involved; and therein lies a most interesting story which would require much space if it were given in full. Some of the salient facts, however, can be stated here and in few words.

A number of the original manufacturers of traction engines and road locomotives made fairly complete drawings of their products, and several of these drawings still exist, fortunately for us! On the other hand, there were some manufacturers who did not prepare proper drawings, but relied upon the older hands in the factory to produce all the details which, when fitted together, would make up into a traction engine. This at once reveals the kind of men who were the craftsmen of those days. They had no need of drawings; through years of experience that bred not only an intimate knowledge of what was required, but a love of craftsmanship for the sake of craftsmanship and a pride in the job, those men knew exactly what was wanted and when. For example, we can imagine those old hands carefully and patiently hand-scraping bearings until exactly the right fit was achieved. Years of practice at this art taught them just when to stop; and seldom, if ever was a mistake made by one who had thoroughly acquired the right "feel" of the job. The result was, of course, an engine which, in most cases, gave fifty years of service. How different it all is today!



A Vertical-boiler Roller

● FROM A reader who describes himself as "A Model Engineer on Tour," we have received the photograph reproduced on this page, together with a letter in which he states that, to him, the roller is of a very unusual type. His letter goes on: "The picture was taken in Calcutta early this year; but as, on that particular day, a riot had occurred only 400 yards away, resulting in about four deaths, I was advised by a policeman to move on before I could collect any details, not even the maker's name."

It is certainly a very long time since we saw a steamroller of this type. At one time such rollers could sometimes be found in the streets of London and the suburbs, and seemed to be used principally for rolling top-coats of asphalt, for which work they appeared to be thoroughly suitable.

We would like to thank our correspondent for thinking of those of his fellow-readers who would be interested in his capture.

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

THE " Model Engineer " Contributors' Stand, No. 53, was given over entirely to the " Twin Sisters " locomotives during the last exhibition, and it did not take readers very long to find it out. It was an interesting and instructive ten days, and I personally enjoyed it very much and learned a great deal about my readers' needs and points of view.

It was a good thing also to be able to chat with the folk who previously had written to me, presenting problems and making suggestions, and those little conversations did more good than perhaps a dozen articles.

For those who were unable to attend, I would point out that the " Twins " were there together —not " Major " and " Minor," but my own " Major " and the same job being built by Mr. Duncan. Both engines were in a state quite some way ahead of the articles, and this made their inspection rather more interesting. Both were fitted with cylinders and valve chests, whilst on my own engine the track-driven water pump also appeared. Other details of springing, draw hooks and chains were all there, and the units sported stove enamelled frames in matt black, and signal-red buffer plank and insides to frames and stretchers.

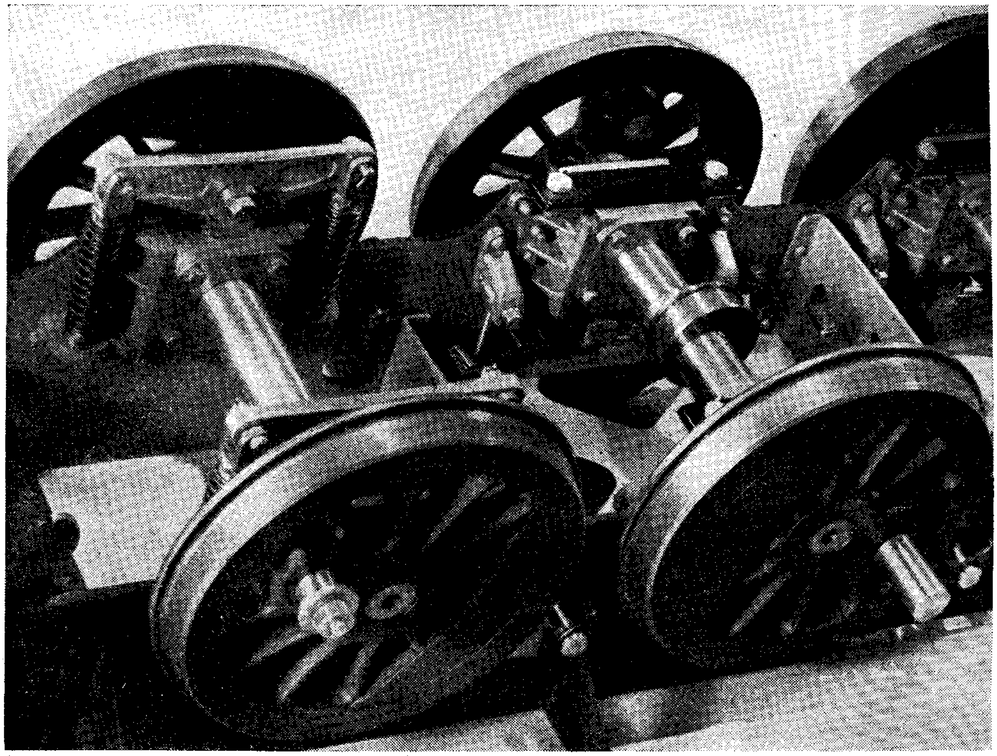


Photo by] [*A. Duncan*

Trailing suspension system, showing the original one-hole fixing for the equaliser beam

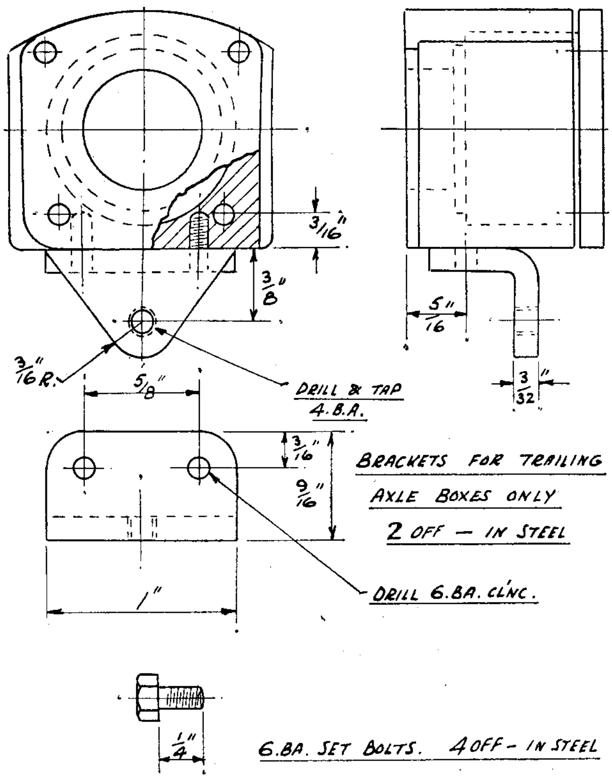
I do not know exactly how much my visitors learned, but from their comments I learned a great deal. First, that the use of stainless-steel was far more extensive than I had anticipated, and that the difficulties encountered were not as grave as one might have expected, especially with the unfortunate reputation it still appears to have in the model world. Everyone, I think, without a single exception was more than pleased with the complete strength and rigidity of the sheet metal stretchers, and in this connection I made quite a few practical demonstrations including standing

**Continued from page* 403, " *M.E.*," *September* 29, 1949.

and jumping on the chassis with complete abandon. Needless to say, this made not the slightest impression on the frames but quite a marked impression on the observers.

The only time I ever saw complete dismay was when visitors looked up at the L.M.S. works drawings pinned up at the back of the stand, but after some explanations they all agreed that the work of translating these master drawings into simpler and more readable outlines and dimensions was one that was, fortunately, spared them.

On this score alone, I believe I earned more



sympathy from them than for the entire project of building and writing, to say nothing of the problem of answering countless letters of query—a subject that was discreetly forgotten for the period of the show—than for the actual building of the engine. The object of having the full-size drawings was to enable me to point out the close relationship that exists between the prototype and the miniature, and those who were in any way in doubt about the authenticity of the shape or even existence of any particular part were very soon reassured.

Of course, the whole subject of the wheel and tyre joint was brought up on numerous occasions—the same old argument as to whether this could or could not be seen. Fortunately, I had with me an enlarged photograph of the prototype, taken at about a dozen feet away from the side of the engine ; even from this distance the junction line was clearly marked all round the wheel.

The wheels themselves probably came in for the lion's share of praise ; with the correct oval section spoke and the crescent-shaped balance weights properly built in, they certainly looked the right job.

In one or two cases, doubts were expressed concerning the strength of the leaf springs ; these gave the impression of being too easily flexed to their bottom position, yet, when the entire chassis was placed on the floor and stood on, the distributed weight did not bring the level much below the normal loaded running position, indicating that, in the slacked off position as shown, they were capable of being adjusted to the correct tension, with the greatest of ease. This in itself was a splendid demonstration of the superiority of the open clamped buckle, over the solid buckle type, even though it may be difficult to appreciate in print.

I also had my little " holiday " from the stand, during which time I took my turn with the passenger-hauling track, and a good look over the loco section in the competition enclosure. There is quite a lot I want to say about this, mainly because I feel that we might all learn a good deal from it.

Remembering from the start that I am more than usually critical in this direction, my first and general impression was that sheer weight and size won the day once more. Disregarding this factor, I felt that the quality of the work shown, especially in the smaller jobs, had perhaps reached a new high level. Apart from this, and getting down to the real job of self-appointed critic, I felt a very keen sense of disappointment in seeing the same old faults perpetuated ; that is to say, such things as driving wheels all with the same size balance weights, rivet spacing wildly exaggerated and generally out of scale, and the proportions of parts, both structural and working, so heavy and clumsy that they take away the natural beauty of the job.

Then take crossheads and buffer heads, both these parts go a very long way towards making the engine look either good or bad, and in this instance I refer to the bad. Why must a crosshead be made in the form of a square block, and what does it add either to looks or efficiency ? Nothing, of course ; the nature of the strains carried by a crosshead does not call for a heavy component, and it merely adds weight to the job, and a reciprocating part at that.

And the buffer heads—round heads where they should be oval, and many of these thick and undersized, and often at the wrong working centres. I once tackled a man on this very point ; his engine had very clumsy buffer heads, far too small in diameter, with thin stems, projecting about twice their scale distance from the stocks.

"Oh, yes, I know all about that, but they are only temporary," he said, quite airily, "I shall be making the proper heads—oval, of course, to replace these." Since then I have tried to work out the economy of this method of working, without much success.

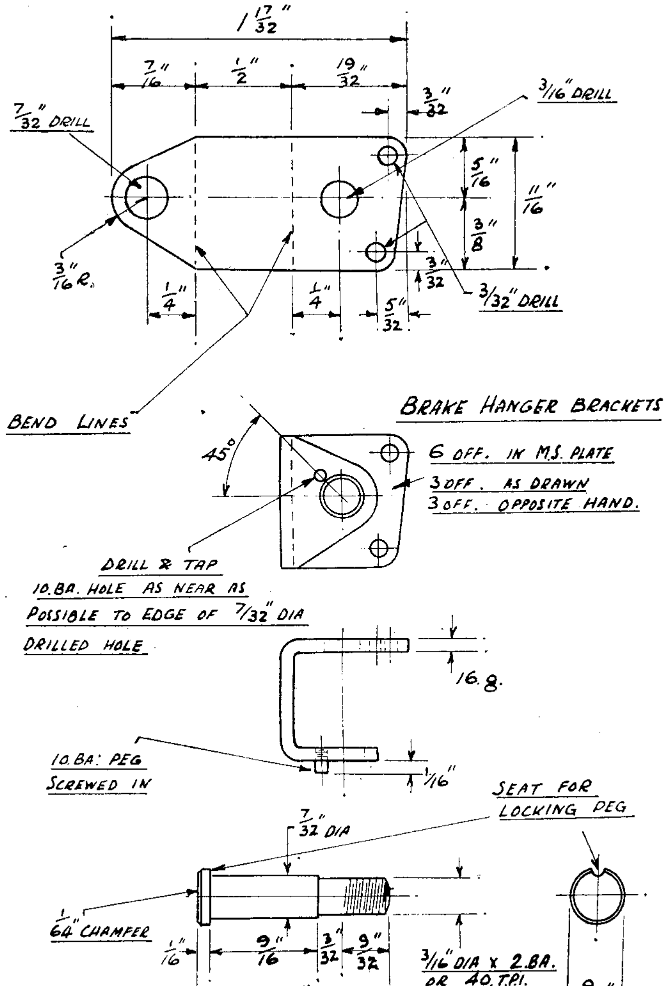
As another example, take leaf spring suspension bolts, or hanger bolts. These are nearly always made far too thick for the job they have to do, and the plea that the engine in question has been made to do a real job of work, holds no water at all. So long as the spring can be depressed to its final stop position, usually controlled by the movement of the axlebox in its horns, without imposing excessive strains on the threads and nuts on the hanger bolts, then nothing can be gained by the installation of heavier bolts, even if you sit on the engine or tender. Of course, bad workmanship might account for some failures which later cause the builder to seek safety in the use of oversize parts. Badly fitting threads may easily cause lack of confidence in the strength of a part, if this man has overlooked the important aspect of *real* strength.

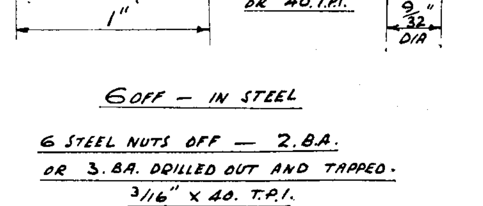
As for scale, I well remember the case of a friend of mine who was building an inch scale locomotive, and he was far enough advanced to be fitting some exterior bolts and nuts to part of the brake gear. Eventually he chose some 2-B.A. bolts and nuts, and not being able to avoid seeing the obvious clumsiness of these parts, he decided to reduce the nuts. When next I saw the engine, he had thinned down the nuts to about half their normal *thickness*, and was evidently quite pleased with the result. He was staggered when I told him my rather candid views, but when, acting on my advice, he had replaced these with some 4-B.A. nuts, re-drilled and tapped, he was the first to comment on their improved appearance. *Sic transit Gloria Swanson* (or something).

Quartering

But now back to serious business, and to deal with a hefty great omission. One of the "Twins" fraternity has written to me, asking for some information regarding the quartering of the wheels on the axles. Fair enough—here are my views :—

From time to time there have been instructions given for the setting out of this job ; one of these being carried out with the aid of accurately made metal squares or templates, whereby the setting is, in effect, done by eye. This is quite a sound method where the operator has good eyes, or is content to have his wheels to the nearest 2 deg. within the specified angle. There is always the danger that the error in the angle may be *plus* on one set of wheels and *minus* on the other, thus





getting a total error of, say, four or five degrees, and getting dangerously noticeable.

Now, anyone having a lathe capable of being fixed up to give quarter turn divisions of the mandrel, say by means of a change-wheel and a rough plunger stop, can quite easily achieve far

more accurate positioning of the wheels on the axles, and the man who has a pukka dividing head on the lathe, is in clover. Now Mr. Duncan, who is building the second "Major," happens to have made his own dividing attachment for his Sphere lathe, so he was made the guinea pig once more.

First of all, the crankpins were pressed into the six wheels, and one of each wheel pressed on to its axle. The axlebox assemblies were threaded on, and pushed right back out of the way. Next, a catch plate was put on the lathe, and both centres inserted. A catch pin was mounted so as to come in contact with the side of the crankpin, just as one would arrange the axle assembly for a normal turning operation. The dividing attachment was put in gear, and the number of turns required for a quarter turn of the mandrel, was noted.

The stub end or shank of a square tool-bit was now put in the toolpost, pointing straight into the centre of the lathe bed, or in other words, at right-angles to the axle itself.

The cross-slide was wound in until the crankpin just rested on the end of the projecting tool-bit, that is, with the driver pin bearing on one side, and the tool-bit preventing further turning of the wheel. The dividing attachment was now engaged and turned until all shake had disappeared. The tool and cross-slide were next wound out of the way, and the saddle traversed along the bed to a position opposite the wheel to be pressed on. This was lightly pushed on to the slight start made on the journal of the axle, and the back centre entered in the bore of the wheel just started on the axle. The dividing-head attachment was now turned the known number of revolutions, and the tool and cross-slide again wound in to provide a stop for the opposite crankpin. It was quite easy to twist the free wheel to a position where its crankpin was supported on the tool-end, whilst the first crankpin was still in contact with the driver-pin on the catchplate. Once this position was found, the entire assembly was removed from the lathe, and the wheel pressed right home in a large vice. Just to make quite sure that nothing had altered during this final operation, all three pairs of wheels were replaced in the lathe and checked back via the dividing-head.

The results were as follows :—

First pair, ¼ deg. out ; second pair, a bare ½ deg. out ; and the last pair, just over ¼ deg. out. Not too bad for a first attempt, and the whole job took less than 20 min., including the setting-up (such as it was).

Brake-hanger Brackets

The next query comes as a result of getting slightly out of step with drawings and the text. In the previous instalment, mention was made of the brake-hanger brackets and their pins, whilst attention was drawn to some tapped holes in the base of the trailing axleboxes, which could not be found on the drawing. Quite correct, and now for the answers. In the first instance, the missing bits are now included, and do not require further explanation.

The tapped holes in the axleboxes are also shown herewith, these are for the fixing of the brackets that carry the equaliser beams. These holes were deliberately left out whilst experiments were being made to avoid breakage through into the bored tunnels of the axleboxes, and with the original single, central tapped hole, this was unavoidable, so now everyone should be happy. Incidentally, do not forget that it is only the trailing axleboxes that require to be treated in this manner.

In order to bring us right into line, you will find an excellent close-up photo of the trailing suspension system, showing the original one-hole fixing for the equaliser beam. This was taken before the improved fixing was thought of, and, although it works quite well and is strong enough, I think you will like the new method even more. Taking a closer look at the photograph, you should be able to discern quite a lot of details that may help you in some other respects, and, in future, I shall endeavour to include more views of this kind.

By way of rounding off this instalment, and harking back to the "M.E." Exhibition once more, I was pleased, and not a little surprised, to learn that over 60 "Majors" were being built in various parts of the country, but never a word about "Minor." Come on, you "Minor" builders, where are you ?

(*To be continued*)

For the Bookshelf

Merchant Ships, 1949-50. Edited by E. C. Talbot-Booth. Samson Low, Marston & Co. Ltd., London. Price £1 11s. 6d.

In addition to its being a valuable book of reference to anyone engaged in the shipping or ship-building industries, this book will be found to be of the greatest interest and value to ship modellers and to all who love ships for their own sake. It contains nearly 2,000 outline drawings of merchant ships of all types arranged according to the system of identification advocated by the author and adopted by the British Admiralty during the recent war. This system is fully explained by detail sketches. Some 450 photographs of ships giving examples of each type are included, as is also a very comprehensive list of the shipping companies of the world with funnel markings, house flags, and other useful particulars. A series of nearly 300 representative drawings of the principal types of merchant vessels (to a scale of 150 ft. to 1 in.) is a valuable feature for the model maker. An addenda to May, 1949, a list of ships building and of ships lost during the war, and a very comprehensive index add greatly to the usefulness of the book. Strongly bound in cloth and with its page size of 12 in. × 10 in., the book makes a handsome addition to one's library.

Joseph Bramah

A Bicentenary Tribute to a Famous Inventor

by W. J. Hughes

JOSEPH BRAMAH, the great engineer and inventor, was born in 1749 at Stainborough, near Barnsley in Yorkshire, on the 2nd April (old style) or 13th April (new style). His father was a servant of the Earl of Stafford, whose home was at Wentworth, and when the latter retired after a career as ambassador and statesman, he made Joseph Bramah (the elder) tenant of nearby Stainborough Lane Farm.

Bramah *pere* had married rather late in life, and Joseph junior was the second son of three boys and two girls. He was educated in the rudimentary fashion of the time at the village school, but early showed an unusual skill with his fingers. It is extremely probable that this skill was fostered by the building of the new Wentworth Castle (which occupied many years), and where he spent a great deal of time as a boy in the workshops of the smiths, the carpenters, and the joiners. It was at this stage of his development that he carved *from solid oak*, with simple hand tools only, a bass viol and a violoncello, which could be played.

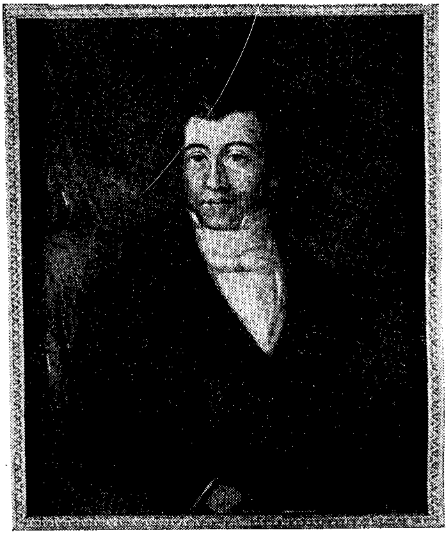


Fig. 1. *Joseph Bramah*, 1749-1814

On leaving school, he was apprenticed to a Mr. Allott, the local joiner and carpenter, and also worked in the local blacksmith's shop. In both these trades he soon became a skilled artisan, and here again it is likely that he was influenced by his environment, for though the district was chiefly rural, there were many charcoal iron furnaces and forges in the vicinity, of many of which there are traces and relics even today. One of them, the Rockley Ironworks, certainly dates back to the monks of the 12th century, and probably to Roman times.

When his apprenticeship was over, it was not long before he went to London as a journeyman cabinet-maker. This was the turning point in his career, and most probably the occurrence has had a great influence on each and every person living today, for it is doubtful if his mechanical and inventive genius could have found sufficient outlet and encouragement in his home surroundings of that period.

Bramah's new master was a cabinet-maker who was engaged, among other pursuits, in fitting the "new" water-closets in the homes of well-to-do people. (In passing we may mention that this device had been known for a couple of centuries or more, but had only just become "fashionable.") The w.c. of the time was extremely primitive and imperfect, and it was not long before Bramah had brought about many improvements in the contrivance.

At the age of 28 he was in business on his own account (describing himself as a cabinet-maker), and five years later, in 1783, he was elected a Fellow of the Royal Society of Arts; this, and the fact that he was proposed for the honour by the great Dr. Samuel Johnson himself, proves how he had grown in fame and stature. In that year he still styled himself as a cabinet-maker, but in the following year he set up new works in Piccadilly under the title of "engine-maker." Twenty-one years later, removing his works to Pimlico, he is described as an "engineer."

To the general public, perhaps he is best known for inventing the Bramah Lock, which by the way *Pickwick Papers* mentions in a typical Wellerism as "Brahmin lock." This was an entirely novel mechanism of the cylinder type, and it demanded precision work which was beyond the engineering methods of the day. Of course, it could be turned out by hand craftsmanship, but this made its production uneconomical.

The only thing to do, therefore, was to devise machinery capable of an accuracy unknown hitherto, and in the development of this Bramah was greatly assisted by Henry Maudslay, who, at the age of 18, was showing signs of that genius which later made his name as well known as that of his great teacher. During the next three years too the lock itself changed in character, but not in principle, so that the new tools and production methods which were being developed could be applied to its manufacture in quantity. It is by no means certain how much of the development was due to either man—it may be that Bramah's ideas were matched by Maudslay's workmanship—but it is clear that working together these two were paramount in their profession. At 19 years of age Maudsley had been appointed superintendent of the works.

Incidentally, at the Bicentenary Celebrations later to be described, a Bramah lock, made in 1787, was on show. With 12 plungers, the number of possible permutations to open it was more than 479,000,000 and a reward of 200 guineas was offered to anyone who could pick it. The prize was not won until 1851—long after the inventor's death—when a well-known American locksmith visiting the Great Exhibition took up the challenge and succeeded—after fifteen hours! This lock is illustrated in Fig. 2.

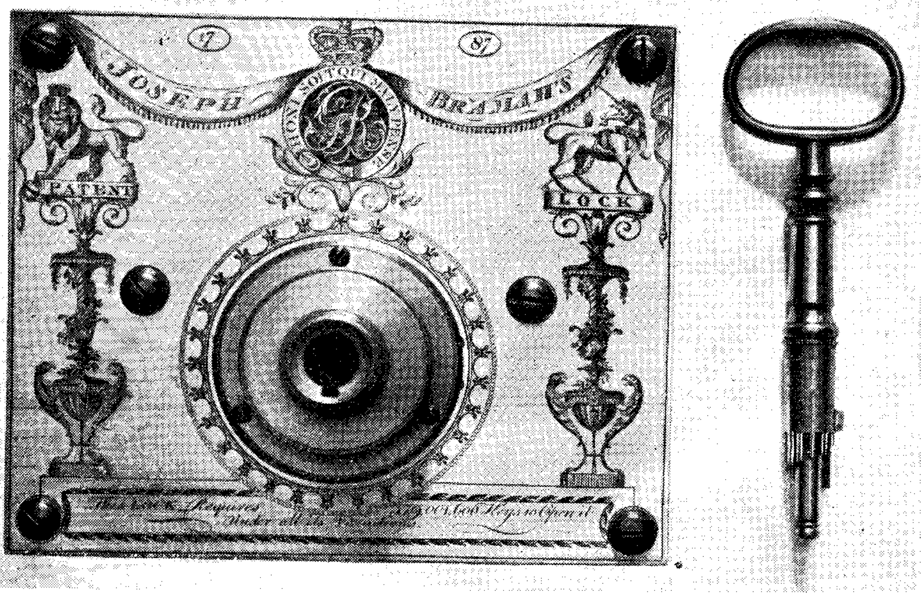


Fig. 2. A Bramah lock and key of 1787 *with more than* 479,000,000 *permutations. The cover plate of brass with its engraving and high finish is typical of the man*

To the model engineer, Bramah may be revered most for his development of the lathe slide-rest. This was no new invention, having been used by French ornamental turners for thirty or forty years, but to Bramah must be credited its use for the first time in engineering and general production. Here again Maudslay shares the credit, as well as for the development of the vee-slides which made it the great success that persists even to this day in almost all machine tools.

Perhaps Bramah's greatest and best achievement was his perfection of the hydraulic press. The principle of this had been known for two hundred years, but the problem was the packing of the piston. By solving this, Bramah and Maudslay not only laid the foundations of the great 6,000 ton presses of today, but also made possible the operation of the Tower Bridge, the retraction of aircraft "undercarts," the reciprocation of modern shapers, and many thousands of other things which add to life's amenities.

And talking of the latter, next time you go to the local for a pint of wallop, raise your tankard to the memory of Joseph Bramah, for he it was who invented that boon to the thirsty, the beer engine! Among his other achievements was a rotary steam engine, which in an altered form gained great success as the rotary pump of a fire engine. This led to a large increase of business, for the firm's workmanship was so superior to that of others of the day.

Another machine invented by this prolific man was one for numbering banknotes, which had been done previously by hand. In fact, the fecundity of his ideas was so remarkable that many of them were only fully implemented by the great engineers who followed him, including Maudslay, Whitworth, and Clement.

We cannot say that Joseph Bramah was the greatest inventor of his age, but we can count him as one of a galaxy of great inventors of the eighteenth and nineteenth centuries, who made Britain pre-eminent in the engineering sphere. It is fashionable in certain quarters to decry the present position of Britain in these circles, but we may recall with satisfaction that the mantle of these masters may be worn not unworthily by Whittle and Watson-Watt, to mention only two of today's great scientist-engineers.

We can say too that Bramah was one of the fathers of present-day mass-production and the precision which it entails. He insisted always on perfect work with a perfect finish to the last detail, and his men could rely on a square deal, for even when work was slack he would keep them on—a practice for which he was severely castigated by other not so broad-minded employers. His works were a nursery for great engineers, and through them his work and

traditions lived on. As was shown recently in THE MODEL ENGINEER, he employed Henry Maudslay and Joseph Clement, and through them was connected with Joseph Whitworth, James Nasmyth, and Richard Roberts, each of whom was a great man in his own right.

No wonder then that Samuel Smiles says of

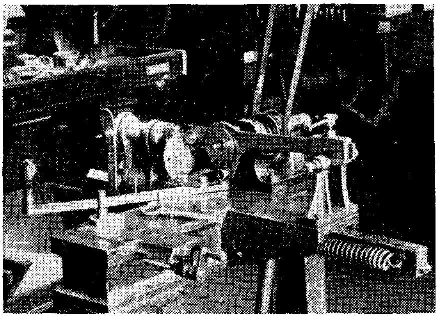


Fig. 3. Key-cutting machine—one of the precision tools specially developed by Bramah and Maudslay for mass-production of the Bramah lock

him that "Bramah was deservedly admired as the first mechanical genius of his time and as the founder of the art of tool-making in its highest branches."

At the age of 65, Bramah was demonstrating personally his hydraulic press for uprooting trees, and unfortunately caught a chill. To this he succumbed on the ninth of December, 1814, and so passed one of England's greatest sons, the rustic who became a mechanical genius. He was survived by one daughter and four sons, three of whom entered the firm, which is still very well known, of course, in the field of engineering.

The Celebrations

In view of the debt which we all owe him, it was fitting that the bicentenary of the birth of Joseph Bramah should be duly celebrated in his home district, and I had the honour of being present at the ceremony. This had been very

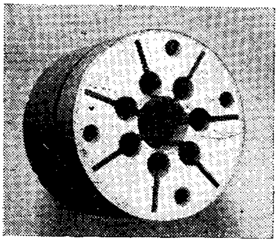


Fig. 4. The barrel of a Bramah lock. It will be appreciated at a glance that this could not be produced in quantity without precision tools, which did not exist when the lock was invented!

well organised by the Sheffield Trades Historical Society, and the large company present included members of that Society, of the Institute of Mechanical Engineers, of the Hunter Archaeological Society, and of the Sorby Scientific Society.

In addition, we were honoured by the presence of more than twenty direct descendants of the great man himself (some of whom had come from as far afield as Glasgow, Hastings and Exmouth), and of Dr. H. W. Dickinson, a past president of the Newcomen Society, who has made a special study of the life and works of Bramah, and who at the age of 79 had travelled up from London especially to pay tribute.

In cars and several coaches the party left Sheffield after lunch on Saturday, April 9th, and drove through the lovely Yorkshire countryside, smiling in the spring sunshine, to Wentworth Castle, which is now the property of the Barnsley Corporation. Here we were officially received by His Worship the Mayor of Barnsley, Alderman H. Burgin, J.P., and then spent some time inspecting the various exhibits relating to Joseph Bramah.

Of these, the first to catch my eye was the banknote numbering press. In this, the standard of workmanship was very high, as it was in some early examples of Bramah locks which lay on a table close at hand. These worked as sweetly and smoothly as on the day they were made, and were wonderful examples of craftsmanship, and indeed of artistry, for the brass cover-plate of one in particular was beautifully engraved, as the photograph shows.

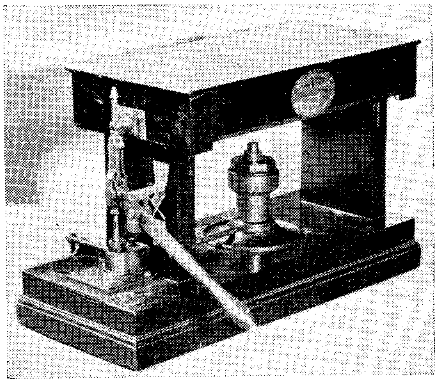


Fig. 5. Bramah hydraulic press of 1796, a tool which has done much to revolutionise engineering and so which affects everyone living today

On another table lay an engraving of the painting by Walker, "Men of Science Living in 1808." On this were easily recognisable Watt, Rennie, Trevithick and other great men, but not Bramah! Oh, no, his back was turned to the artist, for he shunned publicity and had an aversion to having his portrait painted. Indeed, only one portrait of him was ever done, and that is now in the possession of the Institution of Mechanical Engineers. It had been sent off to the celebrations, but unfortunately was delayed in transit and did not arrive in time. It is shown in Fig. 1.

Other exhibits included the original penholder invented by Bramah, and many photographs of his machines and copies of his patents, but before we had had time to examine all these we were asked to take our seats, and the speeches began. I do not propose to report these, but I

must mention that almost all the information quoted earlier about the life and the work of Bramah was extracted from two of them. The first of these was an address by Councillor R. W. Allott, M.A., F.R.S.A., on the "Life of Joseph Bramah, the Man," and the second a lecture by Dr. H. W. Dickinson, Eng. D., on "The Work of Joseph Bramah, the Engineer and Inventor," both of which were extremely interesting.

Following these, we were free for a short time for further inspection of the exhibits, and most of the company went down the magnificent oak-panelled staircase to the terrace on the South Front of the Castle, where what was to me the *piece de resistance*—the original fire-engine, dated 1791, made by Bramah for William, Earl of Stratford, for use at Wentworth Castle. It was in use there until the end of the 19th century, and is now the property of the Barnsley Fire Brigade, who have put it in order again. It has a wooden tank mounted on four cast-iron wheels, and the rotary pump is mounted on a pedestal surmounted by a spun copper pressure-vessel. The pump is operated by dual levers fitted with long wooden handles, to be operated by up to eight men.

After photographs and cine films had been taken, the coaches and cars were filled again, and we visited the smithy where Bramah worked, the farm where he was born, and finally Silkstone Church, where C. M. Bramah, his great-great-grandson, laid a wreath below the tablet which commemorates the great engineer.

By the way, those who pine for the "good old days" should pay a visit to Silkstone, where in the churchyard is a memorial to twenty-eight "persons" accidentally drowned while working in the colliery. These miners included a boy and a girl of *seven* years of age, and many others not in their teens; the oldest was eighteen. The date? 1810!

Next came tea in Barnsley, following which three of us slipped away to inspect a derelict showman's road loco close by. This is not the place to describe this, but for any reader in that area who wishes to build a three-speed Burrell, there it stands in the grounds of the Tollgate Hotel, Barnsley.*

Rejoining the main party, we went across to the Town Hall, where more speeches were made, but at too great a length to report; then after inspecting the magnificent appointments of some of the principal rooms of the Town Hall, of which the Mayor was justifiably proud, we returned to Sheffield, conscious of a day well spent in commemorating a past event which vitally affected the present and the future of all of us.

In conclusion, I must thank The Sheffield Trades Historical Society (and especially Councillor R. W. Allott) for the excellent organisation; and sincere thanks are also due to the Editor of the *Hardware Trade Journal*, for the very kind loan of blocks for illustration purposes.

*I understand that since I wrote the above, the Burrell has disappeared, presumably for scrap. However, with the Editor's permission, I propose to describe this in a later article.

"Token" Working at the "M.E." Exhibition

by A. J. Maxwell

THE use of a token on the S.M. & E.E. tracks at the "Model Engineer" Exhibition, 1949, appeared to arouse considerable interest and was the subject of numerous questions from the many onlookers. The reason for the precaution was that, owing to the layout of the stand on which stationary engines and pumps working under compressed air were displayed, it was necessary to curve the $7\frac{1}{2}$-in. track inwards towards the elevated multiple-gauge track within a few yards of the starting point and then run parallel with it, the clearances, however, being too small for both trains to run at the same time without danger of fouling each other.

It was therefore decided to introduce an adaptation of the well-known single-line working, by regarding the two tracks as a single line section—the working instructions to the enginemen being that neither train must leave the loading point unless both trains were stationary there.

As an additional precaution, a "token," consisting of a small train-staff of the looped type, was provided, and enginemen were strictly forbidden to enter the section without carrying this token upon their engines as authority to do so.

The staff was passed by one driver to the other immediately on returning to the loading point. So well did the system work that, although "Token" working was strange to a number of the drivers, not once during working hours did a driver start away or travel through section without the staff—an exceedingly creditable fact, all things considered. In this way was a safeguard used in full size railway practice successfully adapted to 5-in. and $7\frac{1}{2}$-in. gauge working.

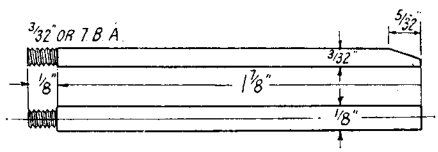
The staff in this case was improvised at short notice, and consisted of a piece of $\frac{3}{16}$-in. copper tube about $3\frac{1}{2}$ in. long with a ring of brass wire $1\frac{1}{2}$ in. diameter at one end—the wire being driven through the length of tube and opened out at the opposite end and hammered over.

This, polished up, made a respectable token of handy size and not too awkward for carrying on the small footplates.

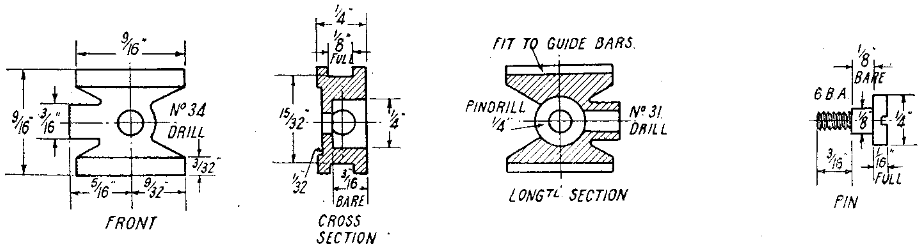
A Wee "Dot" like "Doris"

by "L.B.S.C."

THERE is no need to bother about filing up a posh pair of specially-shaped guide-bars for each cylinder in this small size. The kind shown, look all right, do the job, and are easy enough to make. All you need are four pieces of 3/32-in. by $\frac{1}{8}$-in. silver-steel, each 2 in. long. Chuck each truly in the four-jaw, turn down $\frac{1}{8}$ in. of one end to 3/32 in. diameter, and screw 3/32 in. or 7 B.A. to match the tapped hole in the gland boss on the cylinder cover. Then bevel off the outer ends with a file, as shown. Tip to beginners: screw each guide bar into the gland boss *before* filing the bevel. If you don't it's a million dollars to a pinch of snuff, that the guide-bar will seat home with the bevel upside down—such is the general cussedness of things in this benighted world—and when you attempt to get the other half-turn, bing goes the end of the screw, and you've had it! Either file the bevels with the bars in place—I have no trouble in gripping the ends of the bars in the bench vice—or mark which is top and bottom, take them out, file the bevel, and replace. If the holes in the bosses have been truly drilled and tapped, and the ends of the bars screwed with the die in the tailstock holder, both bars should be parallel with the piston-rod when fully extended, and the bars screwed home. If not, they will stand a weeny bit of coaxing, but not much; so watch your step!



Guide bars



Crossheads

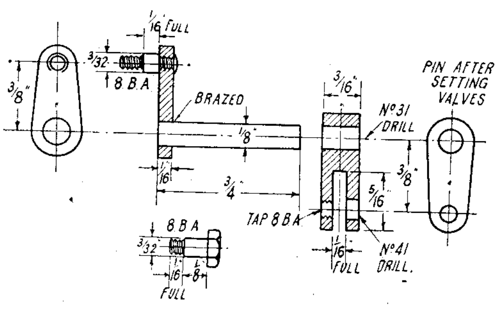
The crossheads differ from the $3\frac{1}{2}$-in. gauge size, in being of the single-sided pattern, very easy to make and fit. No need to carve them out of solid steel for a gauge "1" engine. A bit of nickel-bronze (German silver) would do, or ordinary bronze or gunmetal; it can easily be tinned over, if you are scared of our old friend Inspector Meticulous. A piece of $\frac{9}{16}$-in. by $\frac{1}{4}$-in. section, or nearest larger, about $1\frac{3}{8}$ in. long, will make the pair of them. The grooves can be end-milled out, same as axleboxes, or cut on a planer or shaper, with a parting-tool a full $\frac{1}{8}$ in. wide, in the clapper box. If you set your slide-gauge to the same distance between the jaws, as the guide-bars, the right depth of groove is easily obtained. Cut the grooves each side of the piece of metal first; then chuck truly in four-jaw, turn and drill the bosses, mark off and pin-drill the backs, then saw or part off the piece in the middle, and finish with a three-cornered file. A good way for beginners to drill the bosses, is to mark them in place, using the cylinder cover for a jig. Take off the cover, put the cross-head between the bars and run it right up to the gland. Hold it there with a toolmaker's cramp, and poke a No. 30 drill through the stuffing-box and gland, making a countersink on the boss of the crosshead. Remove the crosshead, and drill out the counter-sink with No. 31 drill, either on a drilling machine, or by chucking the crosshead in the four-jaw again, with the countersink running truly. Don't pin the crossheads to the piston-rods until the connecting-rods have been made and fitted.

Guide Yokes or Motion Brackets

The brackets for supporting the guide-bars may be little castings of the same pattern as used on the $3\frac{1}{2}$-in. gauge engine, or cut out of 3/32-in. steel. In the former case they only need cleaning up with a file, and drilling for the screws. Plate brackets may either have the attaching flange bent up from the self-material, or have a bit of angle riveted on. Don't forget you need one right-hand and one left-hand. The illustration gives the sizes, so no further explanation is necessary. The brackets also are erected after the connecting-rods are fitted, and these form the next job.

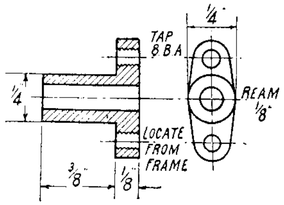
Connecting-rods

The connecting-rods can be milled, or sawn and filed, from $\frac{1}{2}$-in. by $\frac{1}{8}$-in. flat mild-steel, the sizes being shown in the drawing. The little-end doesn't need bushing, though it might be case-hardened, if anybody likes to take the trouble to do it. Just heat to red, roll the eye



Rocking shaft and levers

in any good case-hardening powder, such as "Kasenit," "Pearlite," etc., filling up the hole. Reheat until the yellow flame dies away, then quench in water, and clean up. The big-end should be bushed, as it has to stand the whole driving stress, so drill the hole $\frac{3}{16}$ in., and turn up a bush for each rod, from $\frac{1}{4}$-in. round bronze. This should, when pressed home, stand just proud of the back of the rod; 1/64 in. is plenty. The outside flange should stand out 1/32 in. as shown. There is no real need to drill an oil-hole, but it looks better with one; also, the driver might go on strike if there is nowhere on the big-end to poke in the spout of his beloved oil-feeder! Incidentally, if some motorists I know, took the same interest in their oil feeders, and used them as we did, there wouldn't be such a lot of rattling steering-gears, wobbling wheels, and so on! You don't find any dry pins and bushes under the leading end of my gasoline buggy, or anywhere else on her, if it comes to that. The



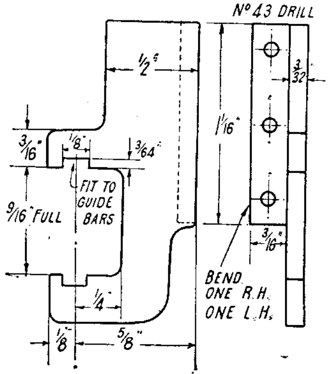
Rocking shaft bearings

garageman down at the end of our road—who, incidentally, owns an "inch-scale" Stirling eight-footer—says that a few more clients like your humble servant, would land him, not in the workshop, but in the workhouse!

The connecting-rods are attached to the crossheads by special large-headed pins turned up from $\frac{1}{4}$-in. round steel rod, to the sizes given in the illustration; this needs no detailing out. When the guide-bars, crossheads, and connecting-rods are attached to the cylinders, they are ready for erection; but if you are using the recommended loose eccentric valve gear, wait until the eccentrics are assembled on the driving axle, and the wheels pressed on "for keeps," before attaching them to frames.

Eccentrics and Stop Collars

The eccentric sheaves, or tumblers, are turned from $\frac{3}{4}$-in. round mild-steel held in the three-jaw; another simple job. Aim for the smoothest possible finish. The toolmarks will indicate the true centre; and if a line is scribed across it, what Pat would call the "eccentric centre," and the hole for the stop pin, can be set out on it as shown. Beginners would do well to chuck the eccentric in the four-jaw, with the pop-mark for the axle hole running truly, and drill and ream with the necessary weapons in the tailstock chuck. The eccentrics only need to wobble up and down, not sideways! Also, the fit of the sheaves on the axle, should be as close as possible, consistent with freedom to turn. They must not be sloppy; one of my correspondents had a gauge "1" engine with loose eccentric gear, and "loose" described it exactly. He complained that it kept



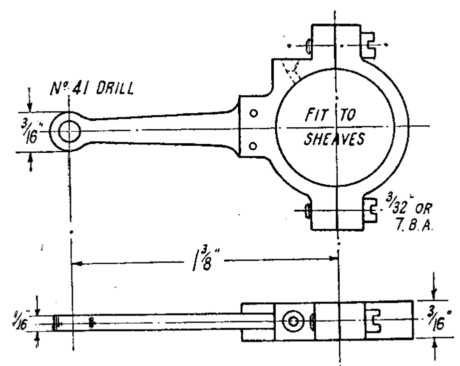
Guide-bar brackets

on "seizing up" when running, and had eased every blessed thing on it that could possibly be eased. I had to grin when I saw it, and stopped the "seizing up" in a few seconds by merely tightening the valve spindle glands! What was happening was that the motion work was so loose and sloppy, that when the engine was running slowly, as soon as each eccentric passed the top centre, the weight of the tumbler and the strap caused it to fall down in advance of the stop pin, shutting the port and "stopping the clock." The bit of extra friction caused by tightening the spindle glands, was just too much to allow the eccentric to operate the valve without being pushed by the stop collar. The stop pins in the present eccentrics are bits of 3/32-in. silver-steel squeezed into No. 43 drill holes.

The stop collars are simply $\frac{1}{4}$-in. slices of $\frac{3}{4}$-in. rod (brass or steel) with a segment milled, planed, or sawn and filed away as shown. Drill a No. 48 hole in the thick side, and tap 3/32 in. or 7 B.A. for a set-screw. I wonder if those good folk who raise objections to set-screwed eccentrics, stop

collars and so on, know that this has often been done in full-size practice. Many locomotives have their eccentrics set-screwed to the axle, the screws having "cupped points" (says Pat) which are hardened, and when they are screwed home, they bite into the soft steel of the axle so deeply that there is no earthly chance of any movement. The holes into which the heads are sunk, are then filled up with white metal, flush with the rubbing surface of the sheaves, and thus it is also impossible for the set-screws to slack back. I've done the same thing with slotted screw-heads in small eccentrics, and never had one shift yet, all the years I have been locomotive building.

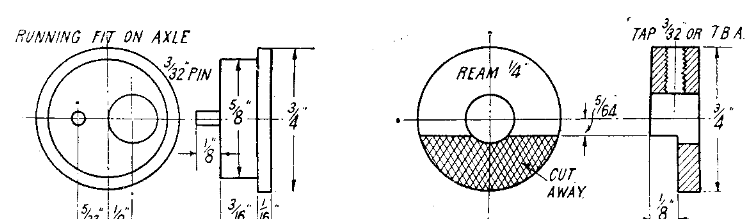
The eccentric straps are castings; don't forget to saw them across, using vice top as guide, and screw the halves together before boring to fit the tumblers. Here again, they should fit easily



Eccentric straps and rods

without shake. The rods are filed up from $\frac{1}{16}$-in. by $\frac{5}{16}$-in. mild-steel strip, and riveted and soldered into grooves in the lugs on the straps. Bits of domestic blanket pins make nobby rivets for jobs like this; drill the holes a tight fit for the pins, and countersink both sides. The eyes can be case-hardened if you so desire.

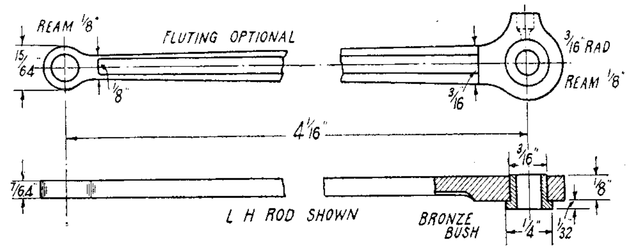
When assembling the eccentrics on the driving axle, note that the flange goes up against the axlebox, and the gap in the stop collar goes over the driving pin; see plan view of the whole box of tricks. The driving wheels can then be quartered, squeezed home, and the coupling rods erected "for keeps."



Loose eccentrics and stop collars

How to Erect Cylinders

About the easiest way I know for a beginner to erect little cylinders on an engine like this, is to turn a $\frac{3}{16}$-in. pip about $\frac{1}{8}$ in.



Connecting-rods

long, on the end of a bit of $\frac{1}{4}$-in. by 40 rod held in three-jaw. Screw it $\frac{3}{16}$-in. by 40, and part off about $\frac{3}{16}$ in. from the shoulder. Screw this into the exhaust pipe hole in the cylinder. Attach crosshead and connecting-rod, slide the guide-bar bracket over the bars, and put the whole issue in place against the frame with the brass plug going through the $\frac{1}{4}$-in. exhaust pipe hole in the frame. Pull the piston-rod out as far as it will go, and line it up with the centre-line of motion. If you haven't got this marked on the frame, don't let that worry you. Get a bit of sewing cotton, stretch it tight, and hold it above the centre-line of the piston-rod, parallel with it, full length. If the other end of the cotton passes across the centre of the driving axle in running position ($\frac{3}{8}$ in. from bottom of frame), the cylinder is set O.K. If not, simply adjust the cylinder until you get it right. Then put a toolmaker's cramp over the cylinder and frame, poke a No. 34 drill through the holes in both frames at once, making countersinks on the bolting face; remove cylinder, drill countersinks No. 44, and tap 6 B.A.

Put a couple of 6-B.A. screws in, to hold cylinder temporarily. Set the guide-bar bracket in position shown in illustrations, and attach it to frame by three 8-B.A. screws. This size is better than 3/32 in. or 7 B.A. for many jobs, as the thread is just as strong, but the heads are smaller; however, if you haven't any, just make use of what you've got. Now push the piston-rod bang up against the front cylinder cover, and put the crank on front dead centre. The boss of the crosshead will go over the end of the rod. Advance the rod another 1/32 in. into the boss, and pin boss to rod with a bit of $\frac{1}{16}$-in. silver-steel or 16-gauge spoke wire, squeezed into a No. 52 hole drilled through boss and rod.

Rocking Shafts for Valve-gear

The movement of the eccentric rod is transmitted " upstairs and outside " by a little rocking shaft with opposed levers; see illustrations. The bearings for each of these, fits into the $\frac{1}{4}$-in. hole in the frames, between the leading coupled and driving wheels. To make one, just chuck a bit of $\frac{5}{8}$-in. round rod (bronze or gunmetal) in three-jaw, turn down $\frac{3}{8}$ in. length to $\frac{1}{4}$ in. diameter, and part off $\frac{1}{8}$ in. from shoulder. Reverse in chuck, centre, drill through with No. 34 drill, and ream $\frac{1}{8}$ in. File the flange oval, as shown. At 3/32 in. above and below the $\frac{1}{4}$-in. hole in frame, drill a No. 43 hole and countersink it. Put the flange in place from inside the frame, and secure with a couple of 8-B.A. countersunk screws, as shown in the cross-section.

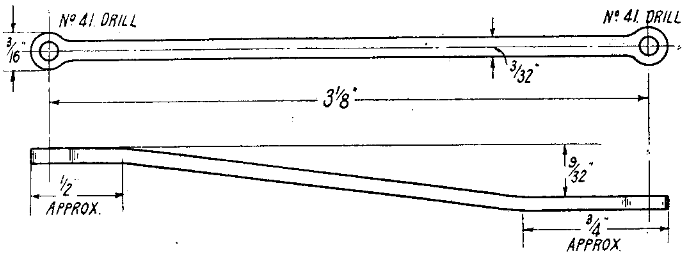
The shaft is a $\frac{3}{4}$-in. length of $\frac{1}{8}$-in. round silver-steel. The outside lever is filed to shape from any odd bit of $\frac{1}{16}$-in. steel, the larger end being drilled and reamed a tight fit for the shaft, to which it is brazed or silver-soldered. The small end carries a 3/32-in. pin, screwed in and riveted over at the back. The inner arm is $\frac{3}{16}$ in. thick, and is slotted, as shown, to accommodate the eccentric-rod eye. One side of the slot is drilled No. 41, and the other tapped 8 B.A. to take the special pin shown in the drawing; this can be turned up from a bit of $\frac{3}{16}$-in. hexagon steel, or the pin may be cheese-headed, just as you fancy. Put a temporary 8-B.A. set-screw in the thick end, to clamp the arm to the shaft whilst valve-setting; when the valves are O.K. it may be pinned.

Valve-rods

If there's one thing I love to see, more than another, in any little locomotive, it is a valve-gear with straight rods; but in the present case we can't have a straight valve-rod, because the outside rocking arms can only extend $\frac{3}{8}$ in. from the frames, otherwise the coupling-rods would hit them. The coupling-rods clear the rocking levers by just 1/32 in., which is quite close enough; but the valve-rods are high enough to miss. They are milled, or sawn and filed, from $\frac{3}{16}$-in. by $\frac{1}{16}$-in. mild-steel strip, to the dimensions given in the illustration; note, the length between the pinhole centres should be $3\frac{1}{8}$ in. *after* the rod has been offset 9/32 in. as shown. If you allow about 1/64 in. extra on the straight rod, it will be all sereny after setting.

How to Assemble the Valve-gear

There is nothing difficult about assembly and erection. Pin the leading end of the valve-rod to the fork on the spindle, by a bit of 3/32-in. silver-steel turned down each end to $\frac{1}{16}$ in., screwed either $\frac{1}{16}$ in. or 10 B.A. and furnished with nuts. The back end goes over the pin in the rocker-arm and is nutted, the rocker-shaft being put through the bearing from outside the frame. Put the eye of the eccentric rod in the slot in the inside rocker-arm, and secure it with the special screw. This should be done with the arm and eccentric-rod off the engine, so that the end of the screw, which should project a weeny bit, can be slightly burred over, to prevent it coming adrift when the engine is at work. This is necessary, as there is only $\frac{1}{16}$ in. of thread to keep the screw in place, and we can't locknut it on account of the flange of the rocker bearing getting in the way. Put the rocker-arm on the end of the shaft inside the frame, and put the strap on the eccentric tumbler, securing it with the screws through the lugs as shown. If the set-screw in the stop collar is tightened, ditto the temporary one in the inside rocking-lever, and the wheels turned by hand, the stop collar should catch the eccentric pin against one of its shoulders, and operate the gear easily and smoothly in either direction of rotation of wheels.

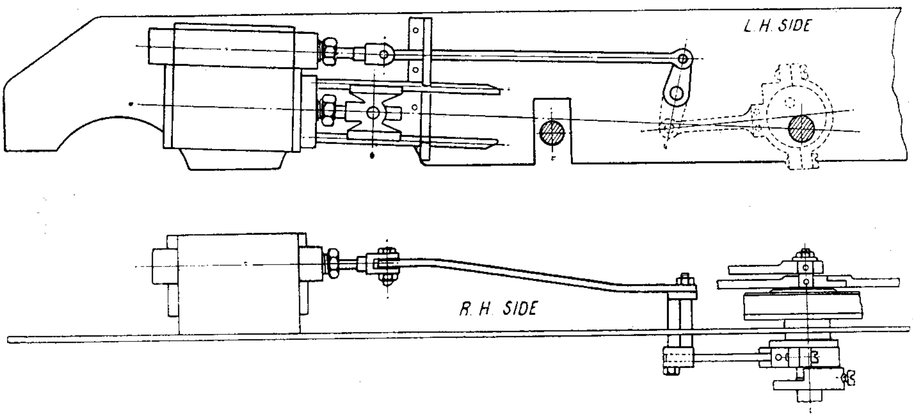


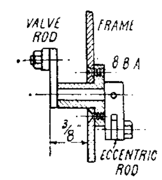
Valve-rods

How to Set the Valves

I usually set my valves under pressure, but for beginners and other inexperienced workers, the valves are set easier by sight. Take off the steamchest covers, and turn the wheels by hand. The valve should uncover both ports an equal amount at each end of the movement. If it doesn't, all you do is to move the inside arm on the spindle, one way or the other, until you get equal port openings, and then tighten up the set-screw. For this job, the stop collars may be tightened in any position.

To set valves, put one of the main cranks on front dead centre, with the piston-rod in as far as it will go. Loosen the corresponding stop-collar set-screw, and give it one turn in the forward direction, to make certain it is driving the eccentric properly. Watch the valve closely. Note when it goes as far towards the front of the steamchest as possible; then, as it comes back, look for a black line at the edge of the valve lap,





Three views, showing arrangement of valve-gear

denoting that the front port has just "cracked" as the enginemen would say. Tighten the set-screw in the stop collar, when this state of affairs is reached; then turn the wheels in the forward direction until the back port cracks. If the crank is exactly on back dead centre, the valve is right length, and the setting correct for forward gear. However, if the crank has not reached the dead centre, the valve is too short, and if the crank has passed the centre, it is too long. The first can best be remedied by a fresh valve; the second, by taking a shade off *both* ends, so as to keep the cavity in the exact centre of the valve. This is very important. After shortening, readjust the stop collar, so as to get the valve just cracking each port on the dead centres.

Now turn the wheel backwards, so that the other shoulders of the stop collars engage the pins in the eccentrics, and watch the valve again.

Trial and Error

If the ports crack on each dead centre, as before, the setting is correct for both directions, and the job is done. If the ports crack *before* the crank reaches dead centre, take a weeny bit off the stop collar shoulder with a little chisel, home-made from a bit of silver-steel. If the ports do not crack until *after* the crank has passed dead centre, make up the stop collar by soldering a little bit of brass to the shoulder. It is merely a question of trial and error. In days gone by, when I was able to do a few jobs for friends, in the way of repairs and overhauls, I sometimes found one opening late; and easily found out the thickness of packing needed, by putting test strips of different thicknesses between the shoulder of the stop collar and the eccentric pin, like using a feeler gauge. When both front and back ports crack on the corresponding dead centres, when turning the wheels either forward or backward, the valve-gear and setting are O.K., and you can tighten up the set-screws in the stop collars "for keeps." Don't be afraid of them shifting; because, despite the moans raised about set-screwed eccentrics, I've never had any trouble with them in any engine in my own "running-shed." The gallons of water that set-screwed eccentric-driven pumps have put into the boilers, is just nobody's business; and I've never had a shifted eccentric in a link motion, or inside Walschaerts gear. Well, that settles the cylinders and motion; now we want some steam to drive them, and a drop of oil to help them do the job; so, all being well, the next instalment will deal with boiler, pipe work, and lubricating and firing arrangements.

Rusty Cylinders

Mention above of doing jobs for friends, calls to mind an overhaul I carried out for an old friend just before Hitler lowered the boom, as Pat would remark. The engine had cast-iron cylinders, with pistons and valves made from a special brand of nickel-iron used in automobile work. If our worthy brother who said that he had never seen a properly-rusted cylinder, had seen what I saw when I dismantled the engine, he would have dropped down in a dead faint. The bores were all pitted, and the port faces were very much like a close-up photo of the moon, complete with craters. Had it not been for the fact that special patterns would have been needed, to replace the cylinders, I would have substituted a bronze pair. As it was, I had to machine a full $\frac{1}{16}$ in. off the port faces, before getting a smooth surface; and to prevent repetition of the rusting, I made and fitted separate hard bronze port faces. The cylinders were bored out as big as the castings would allow, and bronze liners fitted. The new valves and pistons were made from a sample of metal something like monel, sent by an American friend. Like "Sophie Tuckshop" of radio fame, the engine is "all right now." I've had plenty of experiences with small cast-iron cylinders—and experience still teaches!

PETROL ENGINE TOPICS

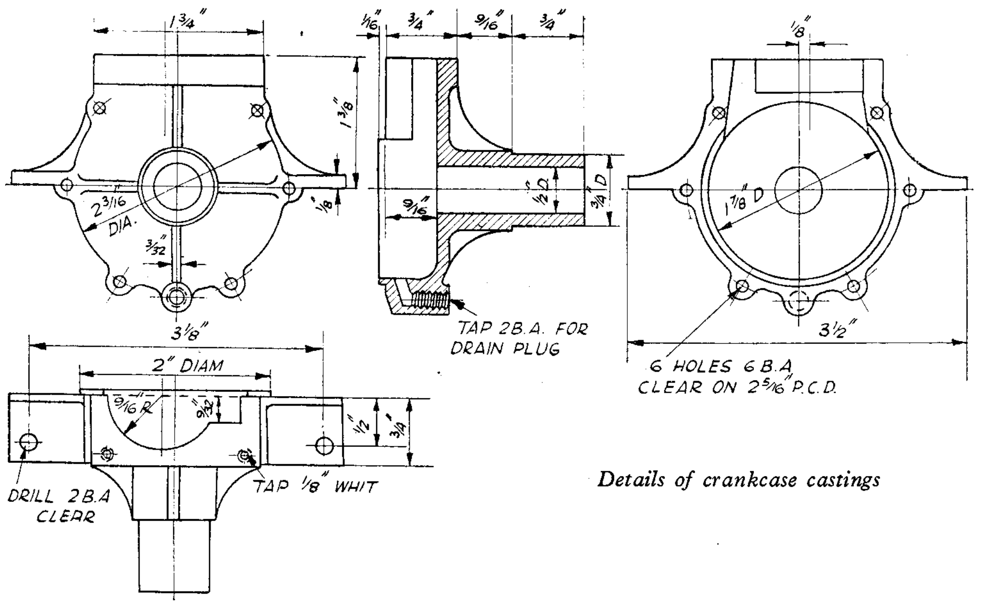
*A General-Purpose 15-c.c. Two-Stroke

An Elementary Exercise in Model Petrol Engine Construction

by Edgar T. Westbury

BEFORE proceeding to describe the construction of this engine, some comments on its origin and history may be of general interest. During the war, I carried out a good deal of development work on small engines for more than one government department, in the course of which both four-stroke and two-stroke engines, of sizes from 35 c.c. down to less than 5 c.c. were produced and tested under very arduous conditions. The object in view, in most of these tests, was to prove the ability of these engines to run continuously for long periods, and to work reliably under extreme climatic conditions such as arctic and tropical temperatures, sandstorms, etc., and it may be noted in passing that after some teething trouble, the desired results were achieved.

It occurred to me at the time that, although the actual engine designs produced for this purpose were highly specialised, particularly in respect of structure and methods of mounting, the internal design was quite capable of being adapted to model engineering requirements. The idea was not followed up, however, until after the war, when the need for a new 15 c.c. two-stroke engine design was expressed by a number of "M.E." readers, who reminded me that I had not produced a design for a two-stroke of this size since the original "Atom Minor" engine appeared in 1932. To comply with this request, I decided to utilise some of the material left over from the above experiments, and it was not long before the engine shown in the photograph was produced. This was quite a successful engine, but unfortunately, its development was never completed owing to a spot of bad luck.



Details of crankcase castings

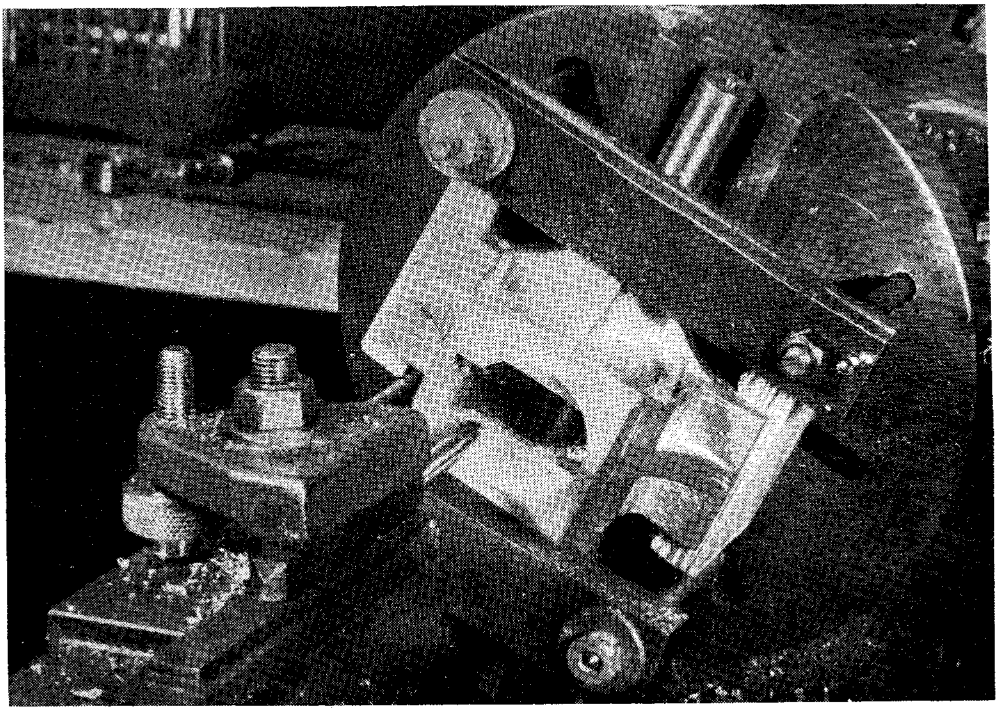
The engine was loaned to a firm interested in the supply of castings and parts for its construction, and while in their possession, the building in which it was stored caught fire, and was completely destroyed, including the one and only existing sample of my engine design. This was quite a nasty set-back, and readers will appreciate that it deterred me from further work on the design for quite a time, but eventually the engine rose again from its ashes, and has thus qualified for the name "Phoenix" almost in a literal sense.

*Continued from page 611, "M.E.," November 10, 1949.

Construction—Machining Crankcase

It will be seen that the two halves of the crankcase, though identical in general features, such as length and diameter of main bearing housings, are necessarily right- and left-handed, and only one half needs to be equipped with a boss for the drain plug—usually it is convenient to fit this on the side opposite the flywheel. Readers who make their own patterns may note that it is possible to cast the two halves from one pattern, if the recess for registering the cylinder spigot is not cast in, but left blank for machining from solid. The drain plug boss may be sawn away from the casting on which it is not required, or alternatively, the pattern may have a loose piece which will allow of casting it either with or without the boss.

The main machining of the crankcase castings may be carried out at one setting, by holding each in turn over the end of the bearing housing in the three-jaw chuck. Before doing so, however, it is advisable first to set them up in the reverse position, gripping by the inside of the crankcase over the steps of the chuck jaws, and take a light skim over the outside surface of the housing, just sufficient to clean it up over the portion which will eventually be machined to $\frac{3}{4}$ in. diam.; but do not reduce it to finished size at this stage. The object of this operation is two-fold: first to produce an accurate and reasonably smooth surface to enable the chuck jaws to grip firmly, and secondly to ensure that when held by this end, and the outer surface set to run as truly as possible, the bore for the bush seating will pass fairly through the centre of the housing, assuming of course, that the chuck is capable of holding work at least fairly truly.

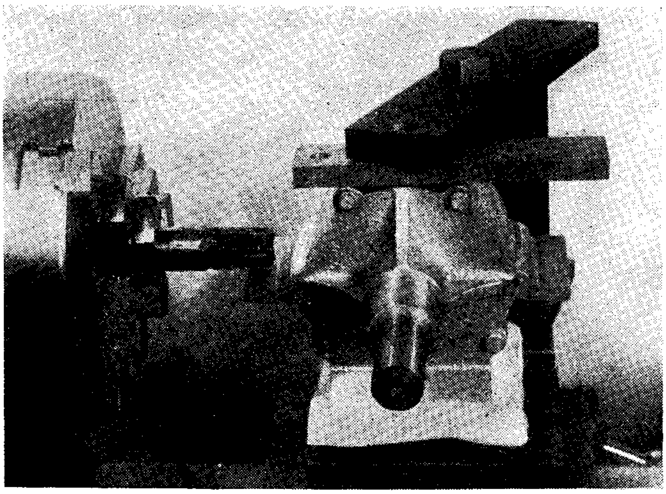


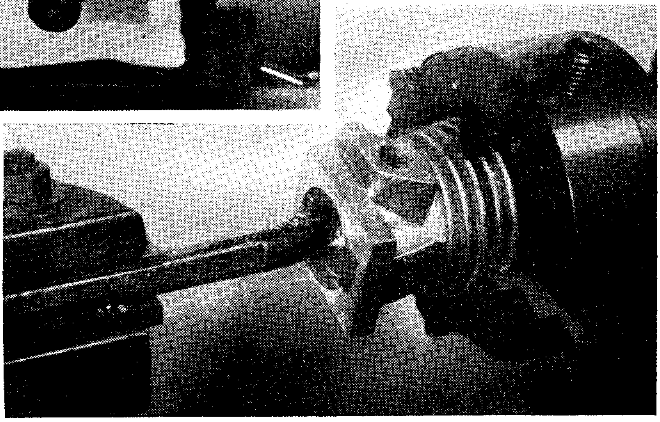
Crankcase mounted on faceplate, using parallel mandrel and vee-blocks to locate square with shaft axis for machining cylinder seating

A point which I have always emphasised in connection with the machining of castings, but which is often neglected by constructors, is that a casting should always be set up for machining by reference to the surfaces which have to be left unmachined. Thus, in setting up a crankcase, the circular part of the outer contour should be checked up by means of a scriber held in the tool post, or some similar method. Never mind about the inside surface, or the face, provided that it has sufficient machining allowance to clean up properly. This precaution is necessary because the accuracy of sand castings cannot be guaranteed, especially when different parts of the surface are cast from the top and bottom halves of the mould, which often have imperfect alignment; and similar errors may occur in the location of cores. If these possible faults are disregarded, one may produce machined parts which are thicker on one side than the other, resulting in weakness at vital points, and also bad external register of mating components.

Another difference in the two crankcase halves should be noted here, namely, the provision for ensuring true alignment by a spigot on one half

and a recess in the other. It does not really matter which is which, so long as they are a good fit; the depth of the recess should be very slightly more than that of the spigot, so that contact of the outer faces is ensured when the parts are assembled. To facilitate fitting, it will usually be found best to machine the recessed side first, and the use of a combined inside and outside gauge, such as a slide gauge of the "Columbus" type, will be found useful to transfer measurements from this to the spigot.





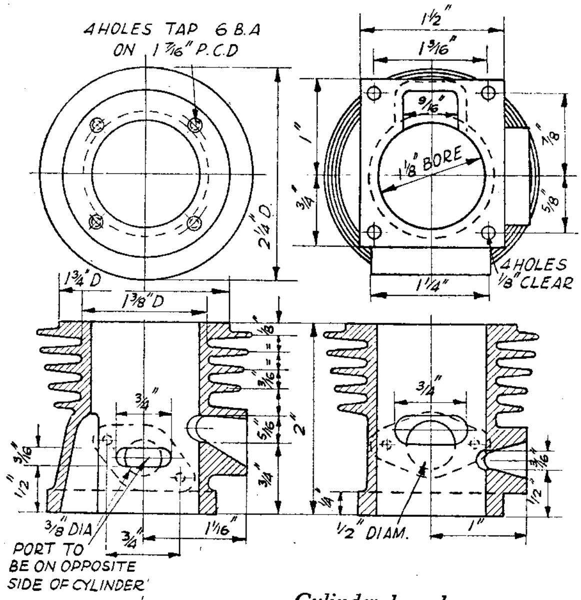
Above—Milling underside surface of crankcase bearer lugs
Right—Boring cylinder barrel in four-jaw chuck

The dimensions of other machined parts of the crankcase are relatively of minor importance, except that the bore should be concentrically true and parallel; the use of a standard reamer to finish the bore will facilitate correct fitting of the bush, but it should first be bored with an internal single-point tool to within 0.005 in. of finished size, so that the reamer is not expected to take out more than a mere scraping of metal.

After machining the two halves at this setting, they should be drilled for the bolts which fasten them together, and temporarily assembled, making certain that the joint surfaces make proper contact and are not held apart by burrs or swarf. The next operation is the facing of the top surface and boring the recess for the cylinder spigot, for which it is necessary to set up the assembly on the faceplate with the shaft axis exactly at right angles to that of the lathe centres. This may be done by various methods, but the most certain way of ensuring accuracy is to locate from a parallel mandrel passing right through the bores of both bearing housings. It may be found convenient to use this mandrel as a direct means of location, by mounting the two projecting ends on parallel vee blocks and clamping them down to the faceplate, or by making small angle brackets of identical dimensions which can be attached to the ends of the mandrel and also to the faceplate. Packing-pieces of wood or metal are then inserted under the crankcase lugs to prevent sideways tilting.

If, however, it is impracticable to mount the work in this way, due to inadequate diameter of faceplate or radius of swing, an alternative method is to clamp the crankcase by its mounting lugs to parallel blocks attached to the faceplate. The mandrel may still be used to ensure correct location of the crankcase axis, by measurement from the faceplate, using the scribing block over the top of it, or inside calipers underneath, but it will be necessary to file or machine the under surface of the lugs true and parallel with the axis first, using the mandrel always as a final check on accuracy. Remember that it is of paramount importance that the finished cylinder mounting platform should be dead parallel to the shaft axis, and any method of mounting which does not positively ensure this is not to be relied upon.

In setting the assembly central on the faceplate, it will be seen that the cylinder spigot recess is offset from the centre of the platform by $\frac{1}{8}$ in. If the recess for the spigot is cast in, it will be necessary to fit a temporary plug of hard wood or soft metal, on which to mark out the centre for this recess, and this point should be set to run dead truly, by shifting the whole assembly and its packing blocks on the faceplate as required. Face the top surface of the crankcase to bring it $1\frac{3}{8}$ in. from the axis, or $1\frac{1}{8}$ in. from the surface of the mandrel, which will be found the most convenient point from which to measure. Bore the recess out



Cylinder barrel

to $1\frac{1}{8}$ in. diam. right through into the crankcase.

After machining, it may be found necessary to file out the mouth of the aperture leading to the transfer passage, which should be $\frac{9}{16}$ in. wide when finished. The underside surfaces of the mounting lugs may be finished by a simple milling process, the crankcase being inverted and clamped down on the cross slide with suitable packing, as shown, and operated on by a milling cutter running in the lathe chuck. A 5/32-in. hole should be drilled in the bottom lug of the crankcase, spot faced, and tapped either 2 B.A. or $\frac{3}{16}$ in. by 40 t.p.i. to take the drain plug, the oblique hole leading into this being drilled from the inside of the crankcase. For finishing the external surface on the nose of the bearing housing, the complete assembly or individual castings may be mounted on a true-running mandrel between centres.

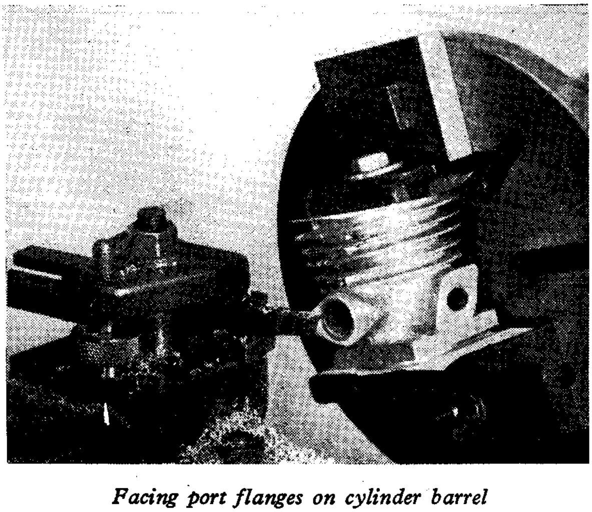
Cylinder Barrel

This casting calls for only relatively simple machining operations, being designed to eliminate the difficulties which often arise in this respect. It is a follow-up of an experiment in the work to which I referred earlier, with the object of testing the behaviour of a light alloy cylinder with an inserted liner under circumstances of continuous use and difficult conditions; incidentally, the results were completely successful.

It is advisable to hold the casting in the chuck—preferably the four-jaw chuck, if only to take advantage of its firmer grip—by the top end, with the finned portion running truly, and the lower end of the barrel also checked by measurement to ensure that the circular portion is as truly concentric as possible. Do not set up from the bore, as it is quite possible that the core may not have been located accurately in the mould. Face the lower surface and bore the inside, taking care to produce a parallel and smooth surface, almost as if this were going to be the actual cylinder bore. But don't use a reamer, as it will surely be deflected by the interruptions in the bore surface and produce an inaccurate hole. It is advisable to locate the end face by reference to measurements from the ports, which are cored in the casting, but, if desired, the face can be left oversize, so that it may be finished after initial assembly, with the bore mounted on a mandrel. The latter will in any case be required to enable the top end of the casting to be faced.

For facing the exhaust and inlet port flanges, it is advisable to mount the casting on an angle plate, by a single bolt through its centre and a disc or plate on top, and attach the latter to the faceplate. Use paper washers to protect the machined surfaces and improve the grip. It is not necessary to centre the flanges exactly, but their angular location should be checked by squaring from the sides of the base flange. Although the latter surfaces do not necessarily have to be machined at all, it is very easy to take a skim off all four of them while set up in this way, and it improves the neatness of the finished engine, if these edges are set dead flush with the corresponding edges of the crankcase platform, which may also be machined, after the required location has been determined on temporary assembly.

(To be continued)



Facing port flanges on cylinder barrel

Improvements and Innovations

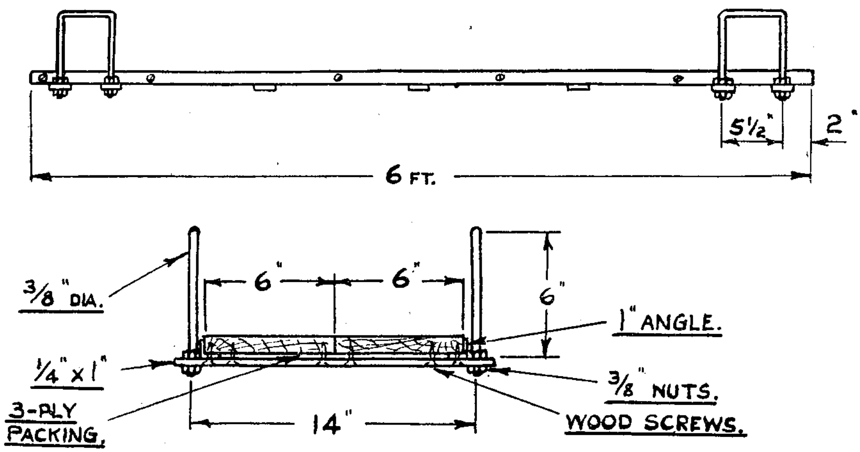
No. 6—A Loco-carrying Board

by "1121"

WE claim no originality for this idea, but as we have not seen it described before, we thought that it might be worth bringing to the general attention of readers.

It is desirable, on occasions, to connect up an engine and tender while steam is being raised away from the track, either because it is required to make some observations or adjustments to injectors and such like before the engine goes into service, or because the engine is being used as a standby ready to relieve, at a moment's notice, one of unknown or doubtful temperament operating on the track. In either case the engine may require to be kept in steam for some time, for which purpose it is more convenient to have its tender coupled up than to mess about with pots of water and trays of coal, and for two reasons it may be better to avoid disconnecting the tender when transporting the engine to the track—firstly because, should a sudden breakdown overtake the doubtful engine in operation, the relief engine will be wanted in a hurry, and secondly because, even if this is not the case, we don't like messing about on the front end of the track for longer than necessary when another engine is running behind us. For one thing, there is the possibility of its driver forgetting we are there and being unable to pull up without biffing our tender and pinching somebody's fingers (see "Dangerous Driving!"), and, for another, our engine is almost certainly standing on one of the electrical treadle contacts which operate our warning-light system, on which the driver is relying for setting back to the rear dead-end.

Under any of these conditions, steam can be raised and maintained for as long as required on the carrying-board, and when wanted the complete engine and tender can be carried to the track all coupled up and ready for service. The new loco is run straight off the board from the front end on to the track, and the retiring loco is run on from the rear end and carried away.



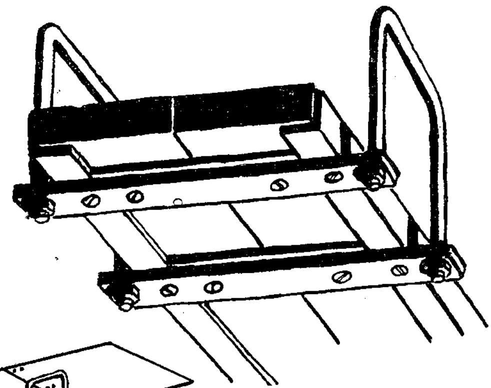
A general view of the board, and a section showing construction

It may be mentioned, in passing, that we have, in the past, encountered certain engines which were apparently designed to be as difficult as possible to couple to and uncouple from their tenders, by virtue of inaccessible hose connections, and frequently incorporating union-nuts requiring a deplorable amount of fiddling with spanners before the engine can be considered as coupled or uncoupled as the case may be. All this fiddling can be done on the board at leisure, even if the engine has to be put on or taken off the track in a hurry. Occasionally, we have engines fitted with vacuum brakes, and have known the brake-pipe hose connection to suck itself on so tightly and vulcanise itself in position so thoroughly as to render it quite impossible to remove by humane means, and in one case of this sort, after a fair amount of struggling we gave it up, ran the engine and tender complete on to our board, whipped it off the track and dumped it on one side for the owner to deal with when he appeared.

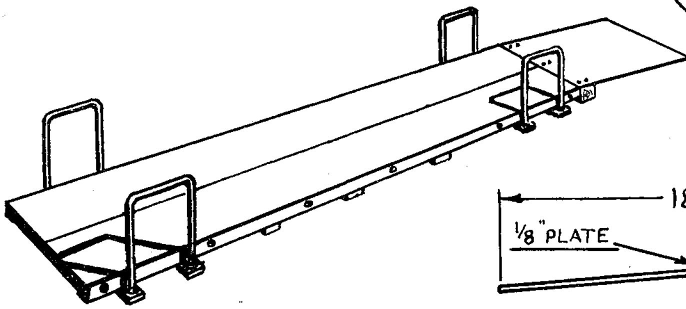
The construction of the board is simplicity itself, and we give sketches showing its main features, and perspective views of the complete article. The only reason for using two 6-in. boards side by side was that we were unable at

the time to obtain one a foot wide, which we considered about the most useful width, although it is probable that any twisting of the wood will have less effect on the flatness of the whole thing than would have been the case had a single wide board been used. The boards are 1 in. thick.

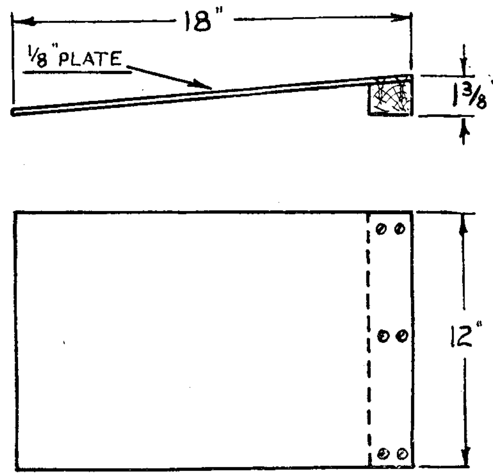
An important feature of the board is that its thickness should be as small as possible, commensurate with adequate strength, in order to minimise the difference in level to be negotiated by an engine being run off or on, and for the same reason the loose ramp is of the maximum convenient length, to minimise the severity of the hump where the ramp joins the board, and more important still, the hollow where it joins



An underneath view of the end of the board



The completed outfit



Details of the ramp

the track, which is the point which usually proves the most awkward. Some comment is also advisable concerning the carrying handles, which, it will be observed, are arranged on a fairly high level without being unduly in the way, or causing excessive inconvenience to the people lifting the weight. By this means the centre of gravity of the loco is kept fairly low, it being anticipated that plain handles near the surface of the board would impart a dangerously "top-heavy" effect to the load being carried.

Another and less intentional use has been found for this piece of equipment on occasions when engines, especially large tank engines, are so heavy and unwieldy that they are difficult or impossible to place on the track from the side. One such specimen we have known necessitated the removal of the front dead-end *and* the first section of trestle so that four people could manoeuvre it on to the end of the track, and this operation is considerably simplified if the engine is on a carrying-board, which can be rested on the end of the track at one end, and on some suitable support at the other, to take the weight while attention is concentrated on the matter of running the engine on to the rails.

Our board has turned out to be somewhat heavy, and a saving in weight could be effected by using duralumin angle and strip in place of steel.

Amusing Registration Numbers

Mr. J. Corbett, hon. secretary of the Yeovil Live Steamers, referring to our photograph of a motor van registered DRY-1, states that in his home-town, Cheltenham, the local registration is AD, and this, combined with various first letters, sometimes produces amusing results. He has noted, for example, a small electric delivery-van owned by a local dairy; on the back of the van is the usual trade name, etc., followed by the words: "Our Milk and Cream are Safe," and immediately below this is a large number-plate with the registration—BAD!

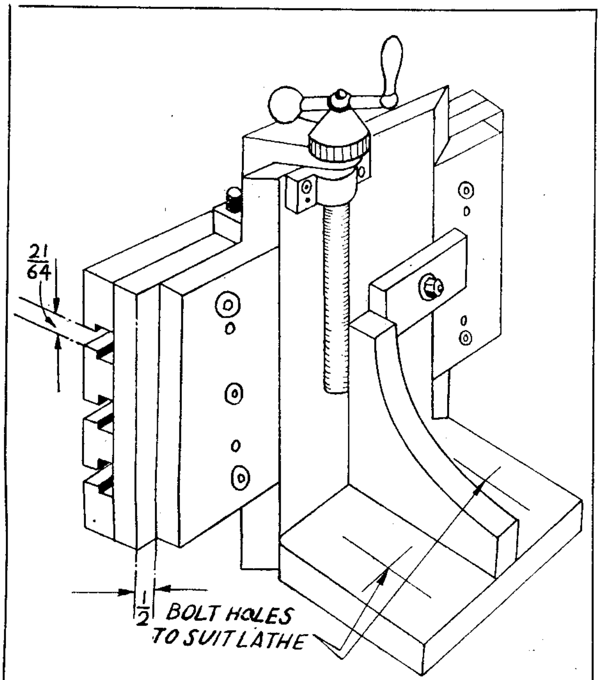
Mr. Corbett adds that he understands that there is no truth in the report that a car seen following a rather erratic course along the Promenade one night was registered "HAD-9."

Why Buy a Vertical Slide?

by A.E.V.

MOST model engineers are, I imagine, like myself, hard-up, and wanting more equipment than they can afford to buy. I wanted a vertical slide at a time when, except for an occasional one at a prohibitive price, vertical slides were unobtainable. So I decided to make one.

After a lot of thought I decided not to use castings because of machining difficulties (the reason for the slide), and after weighing the "pros and cons," decided to use bright mild-steel. Knowing the peculiar vices of this material, I normalised it in the living-room fire (left it in overnight) so as to stop it distorting when I cut and drilled it. I also decided to use Allen screws throughout, because of their high tensile strength and the small counterbores required for the head.



A general perspective view of the vertical slide

The Work Table

First, square up the ends of parts 3 and 4, and mill the rebates as per drawing. I clamped them in the toolpost of my lathe, and packed up the toolpost until the correct depth of cut was obtained, and then fed the cutter into the job by advancing the saddle. After milling, the parts should be drilled as shown in the drawing. Leave the reamed holes 1/64 in. undersize at this stage, then scrape faces *A* and *B* parallel and square to each other.

Next scrape part 1 parallel and flat on faces *A*, *B*, and *C*, and screw parts 3 and 4 to part 1 as shown in the general arrangement drawing, taking care to set them parallel to edge *C*. The method to use is as follows: First, set edge *C* on the lathe bed, then lay part 3 alongside part 1 and clamp together. Transfer the screw-holes from part 3, tap and insert screws before removing clamps. Next, check the alignment of the two edges, and when satisfied that all is correct transfer the dowel holes, ream them and insert the dowels. Part 4 is set similarly by placing 21/64-in. packing between it and part 3, when both parts 3 and 4 are securely attached to part 1; faces *C* of parts 3 and 4 are then scraped flat and parallel to part 1.

Part 2 must now be dealt with. First cut one edge on each at 45 deg. with a hacksaw (coarse blade!) and drill holes as per drawing. Then file and scrape faces *A* and *B*. Next, set one part 2 in position on part 1, check for squareness from edge *C* using a roller against angular face *B*. When "spot on," screw and dowel.

We must now give our attention to part 5. Edges *A* and *B* must be cut at 45 deg. and faces *C* and *D* scraped flat and parallel; then edge *A* should be bedded to parts 2 and 1. Clamp the other part 2 a little way from part 5, and check part 5 for parallelism by moving to and fro, and inserting feeler gauges at the same point on part 2 all the time. When part 5 is parallel, the loose part 2 should be advanced into contact with part 5, which is now bedded in to part 2, and when finished, part 5 should slide evenly from end to end without shake or tightness. Part 2 should be screwed and dowelled to part 1.

Note.—I do not think it necessary to fit a gib-strip, as the mating faces of parts 1 and 2 can always be scraped to take up any wear that might occur.

Angle Bracket

Part 6 should then be cut out and edge *A* scraped. To cut out the profile, a row of holes should be drilled along the curve as close together as possible; the holes can now be joined by an Abrafile, or if you believe in brute force, the required piece should be placed in the vice, and the waste piece given a clout with the coal hammer! The serrations can be removed with a file.

Part 7 is scraped on faces *A* and *B* and part 6 screwed and dowelled to it, and edges *C*

scraped square with face *A*; part 5 should be screwed and dowelled to parts 6 and 7. To ensure accuracy, the setting should be checked (as in sketch) before dowelling.

Leadscrew, Index and Clamp

Details 8 and 15 are now made up and attached in their respective positions. The tapped hole in detail 15 should be drilled and tapped in position while the slide is assembled to ensure alignment.

Details 9, 10, 11, 12, 13 and 14 are self explanatory. Methods of index graduation have been dealt with before in this journal, so I leave it to personal taste as to the method to be adopted.

The function of detail 16 is to lock the slide in any position required, and to stiffen the slide when feeding job into cutter so as to stop the cutter snatching—i.e., when flycutting.

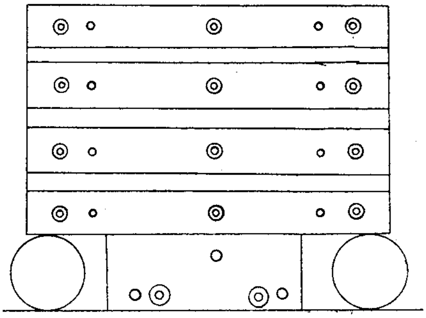
The reasons for using $\frac{3}{8}$-in. B.S.F. for this leadscrew were as follows :—

(*a*) I had no change-wheels for my lathe, and no facilities to get a screw and nut cut.

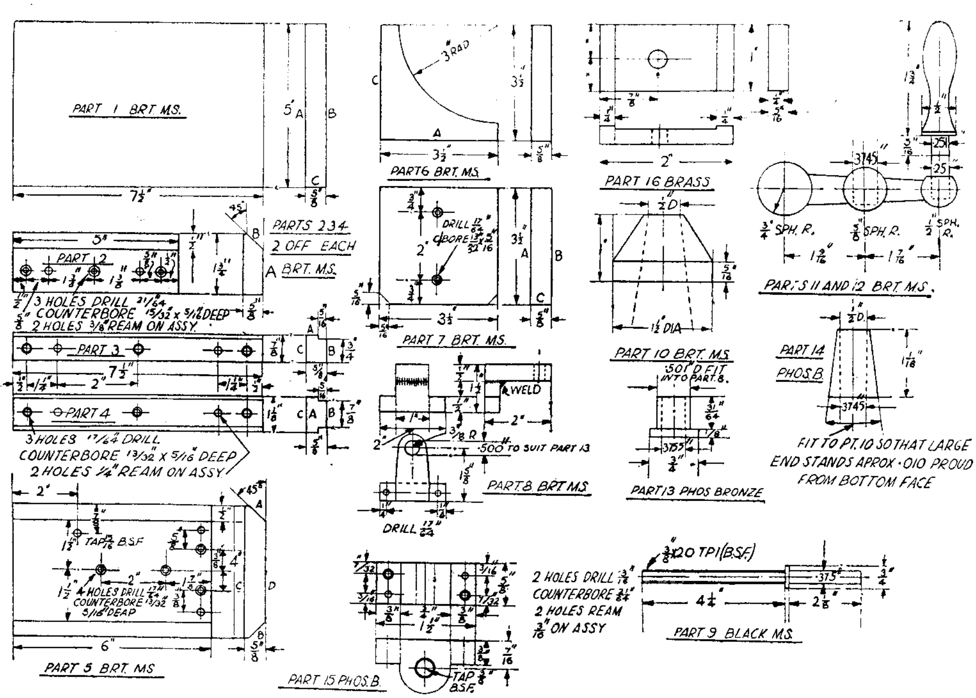
(*b*) $\frac{3}{8}$-in. B.S.F. gives 0.050 advance per turn, which is very convenient when using the slide to jig-bore holes, and gives an even number of divisions on the index.

(I have since screw-cut a leadscrew to replace the one cut with a die.)

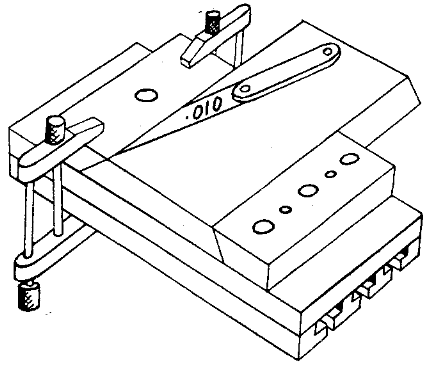
The method of fixing the index has proved quite satisfactory, and the index will not slip if the taper is well fitted. It will be noted that the slide only swivels in one plane (I have never found it necessary to swivel a vertical slide in any other plane). And that the area of the table is greater than can normally be covered by the



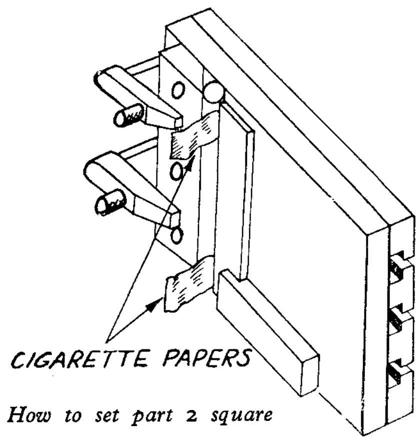
TO SET BASE OF ANGLE BRACKET SQUARE WITH SLIDE. SCREW P+7 TO P+5 WITH ONE SCREW, CLAMP P+7 TO LATHE BED, THEN BRING DOWN WORK TABLE ONTO TWO ROLLERS OF EQUAL DIAMETER, TIGHTEN SCREW AND DRILL REMAINDER OF HOLES.



Details of the vertical slide



Set-up for checking part 5 for parallelism



How to set part 2 square

traverse of a bench lathe; this is deliberately so, as I have bitter memories of jobs that could be covered by the traverse, but were too big to clamp on the slide; also, it allows dividing-heads and other attachments to be set up and yet retain the maximum amount of traverse.

Standard Screw Threads for Model Work

IN view of the obvious desirability of adopting standard screw threads for model fittings wherever possible, and also that the number of standard threads in use should be reduced to the minimum, consistent with covering all essential requirements, the entire subject of model screw thread standards has been reviewed by a sub-committee of the Society of Model and Experimental Engineers, in consultation with the British Standards Institution (of which the society is a member) and also members of the model manufacturing trade, including Messrs. Stuart Turner Ltd., and Bassett-Lowke Ltd. (representing themselves and Messrs. Bond's O' Euston Road, Ltd.). As a result of meetings and discussions, the following recommendations have been issued.

It is recommended that on all model fittings manufactured in the future, one of the following threads should be adopted:

$\frac{1}{8}$ in. diameter × 40 t.p.i.
5/32 in. diameter × 40 t.p.i.
$\frac{3}{16}$ in. diameter × 40 t.p.i.
$\frac{1}{4}$ in. diameter × 32 t.p.i. or 40 t.p.i.
$\frac{5}{16}$ in. and above, 26 t.p.i. (provisional).

The above proposals are qualified by comment on the fact that considerable stocks of fittings having threads different to those specified are in existence, for example, $\frac{3}{16}$ in. × 36 t.p.i., and that as a matter of business, it is expedient to carry on producing fittings with this thread for the time being until present tools and stocks of materials are exhausted; but the assurance of the manufacturers concerned has been obtained that this will not be continued as a long term policy, and obsolescent standards will be abandoned as soon as practicable, in favour of the standards specified above.

In certain cases, the use of $\frac{1}{4}$ in. × 40 t.p.i. has been found undesirable, in view of the fact that so fine a thread is easily damaged by cross-threading in unskilled hands, or liable to strip if used on soft metals such as copper; the adoption of a somewhat coarser thread is permissible in such circumstances, and the committee recommends the use of $\frac{1}{4}$ in. × 32 t.p.i. as an alternative. This will not affect the use of the specified $\frac{1}{4}$ in. × 40 t.p.i. standard for all suitable applications.

The recommendation of 26 t.p.i. for all threads of $\frac{5}{16}$ in. diameter and above is provisional only, and it is agreed with the manufacturing trade that if and when a new British standard thread is introduced, having a finer pitch than B.S.F. (as is likely in the next few years) its suitability will be considered for adoption as standard for model engineer fittings. In the meanwhile, however, it is not considered desirable to complicate matters by introducing new or temporary standard pitches.

Screw Threads for Nuts and Bolts

It is recommended that for threads under $\frac{1}{4}$ in. in diameter, B.A. standard threads should be used, and that the following sizes should be adopted as model engineer standards: Nos. 0, 2, 4, 6, 8 and 10.

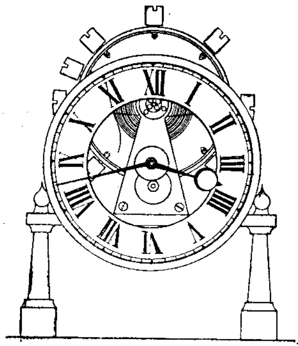
For nuts and bolts of $\frac{1}{4}$ in. diameter and over, B.S.F. standard threads and recommended.

Hexagonal Nuts and Bolt Heads

It is recommended that standard B.A. hexagon sizes for the smaller nuts and bolts, and B.S.F. hexagon sizes for those of $\frac{1}{4}$ in. diameter and over, should be adopted.

These recommendations have been approved and agreed by the representatives of the trade, named above, and may be taken as superseding all previous recommendations on the subject of screw threads issued by the society.

(Condensed paraphrase of report submitted by T. W. Pinnock, chairman, technical sub-committee on screw threads, S.M.E.E.)



*An Electric Clock

with a Semi-free Balance

by Stanley J. Wise, F.B.H.I.

GREAT care is necessary in constructing the front plate to ensure correct alignment of both the centre hole and those accommodating the supporting columns. Mark out the plate as follows :—

(1) On a $3\frac{1}{2}$-in. length of $\frac{1}{16}$-in. brass plate strike an angle of 35 deg., extending over a distance of exactly $2\frac{5}{8}$ in.

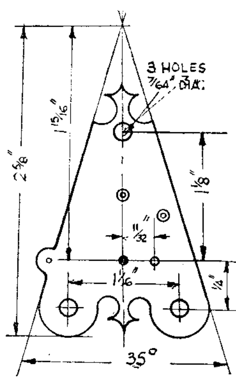


Fig. 15. *Wheel work front plate*

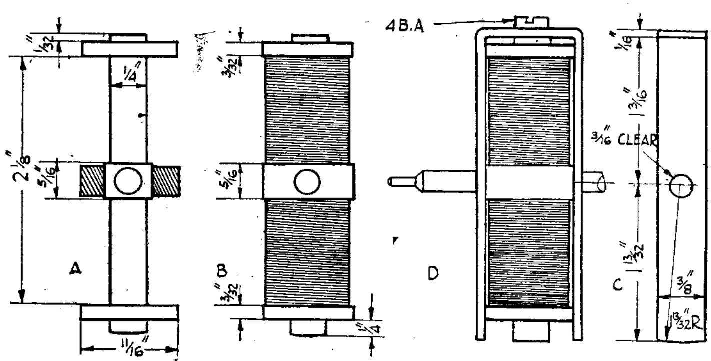


Fig. 16. *Details of working coil and anti-reluctance plates*

(2) From the apex of angle thus formed, accurately scribe a centre line, thus leaving 17.5 deg. on either side.

(3) Again, from the apex, measure a distance of exactly $1\frac{15}{16}$ in., scribing another line at right angles to centre line and mark the intersecting point with a fine drill. This is the position of centre wheel arbor.

(4) From the centre wheel line, mentioned above, scribe another parallel line displaced downwards by $\frac{1}{4}$ in. Now measure a distance along this line of 17/32 in. on each side of centre line, again marking the two intersecting points with a fine drill. This will give the position of the two bottom columns.

(5) From the centre arbor line, strike a further line exactly $1\frac{1}{8}$ in. upwards, this being dead on the centre line and mark position accurately with a drill point. This is the location for single top column.

(6) Scribe out the bottom ornamentation curves at a radius that will exactly meet the downward lines of plate. The remainder of ornamental work can be done by hand after cutting out.

(7) Drill the holes for columns and centre wheel, but do not drill the remaining two pivot holes.

The plate can now be cut out and shaped ; straight grain front and back after removing the surplus from the top. Burnish all edges, including the ornamental curves. Finally drill and tap the 10-B.A. hole for minute wheel studs as shown on drawing. Turn three brass pins each being a tight fit in the column holes and screw one side to take a 6-B.A. nut. These must be of suitable length to enable the two components, i.e. front bearing pedestal, Fig. 14, and front plate, Fig. 15, to be tightly clamped together, after which the remaining 1/64-in. pivot holes can be drilled (including that for rocker), using those already drilled in pedestal for a jig. By this means the holes will be in true alignment. Separate the plates and countersink slightly (from the front) the two wheel pivot holes. Do not countersink the centre hole.

Attach pillars to the back pedestal plate by three long polished 10-B.A. cheese-headed screws ; the holes must be slightly reamed to fit. Also broach slightly the centre wheel bearing hole in front plate, so that the centre

*Continued from page 647, " M.E.," November 17, 1949.

arbor is a nice working fit, and rotates freely when the front plate is pressed tightly on. In a similar manner, slightly broach the remaining pivot holes, so that all wheels are capable of free rotation when "spun round" from the centre wheel by hand, but without undue endshake and no discernible up and down play in pivot holes. The front plate must of course be attached for this. Secure the front plate temporarily by three shallow headed polished steel screws. The heads of these should be nicely blued. Just how to do this will be described later. The remainder of impulse dial mechanism will be explained subsequently.

Balance Coil and Plates

Turn the core to measurements as shown at *A*, Fig. 16, and radius the lower end from centre axis. Allow an increased area at mid position of sufficient mass to allow a hole of $\frac{3}{16}$ in. diameter to be drilled, for the balance staff. Turn three flanges from hard "tufnol," or similar material, and press tightly into their respective positions on the core. It is a good idea to give all three flanges a slightly increased thickness at this stage, thus enabling the whole job to be "skimmed" up dead true in lathe. Drill the centre hole accommodating balance staff, through both insulation and core, slightly less than $\frac{3}{16}$ in. It must, however, be "dead" at right angles, otherwise the coil will lean over when finally mounted, and is extremely difficult to rectify. Polish the edges and outer faces of the flanges. Drill and tap a 4-B.A. centre hole in the upper limb of core, to form an anchorage for anti-reluctance plates.

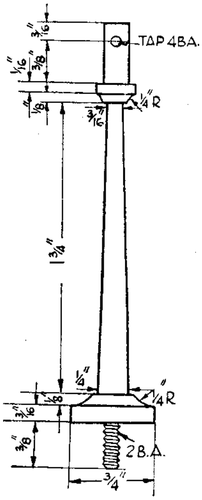


Fig. 17. Contact switch supporting column

The core can now be prepared for winding. First drill a 1/32-in. hole through the upper flange near the core for the purpose of bringing out the starting end of winding, and cut a shallow notch across the edge of centre flange, to accommodate wire connecting the two sections. Wind two layers of thin empire cloth, or similar material, tightly round the core spaces, securing then with a coat of shellac. When thoroughly dry, mount up ready for winding in the lathe; holding bottom limb in chuck and back centre registering with 4-B.A. screw hole in upper limb.

The winding can now be proceeded with as follows :—

(1) Thread a length of fine flexible wire through the 1/32-in. hole, drilled near the core, allowing about 4 in. projecting outside the flange, and wind about five turns tightly on the core. Secure the end with a mere spot of solder to its adjacent turn.

(2) Solder the starting end of your winding to soldered joint of flex and wind on the first layer of 36 s.w.g. enamelled wire. Level up this first layer by sheathing it with one thickness of rather stiff paper. Fill the remaining space, as evenly as possible, leaving approximately the thickness of two layers unwound.

(3) Again sheath the winding with stiff paper and *very carefully* wind on evenly the last layer. Go slow when doing this and the result will be very pleasing. Secure the last turn, which should be at bottom, with a couple of turns of fine thread.

(4) Carry the wire through notch in centre flange edge, and proceed to wind the lower section, interposing a thin split paper disc to protect the "lead down" wire, from the mains winding. Wind as evenly as possible leaving about the thickness of four layers unwound.

(5) Very carefully, with the smallest possible amount of solder, attach to the finishing end about 5 in. of fine flexible wire (about twice the thickness of that used for winding), and wind back about five turns, securing them with a few turns of thread; the latter being held neatly in place with shellac. The appearance should now look like that shown at *B*, Fig. 16.

Proceed to shape out the anti-reluctance plates shown at *C*, from good quality $\frac{1}{16}$ in. soft iron plate. Radius the lower end to measurements after bending. Keep the corners as sharp as possible. Drill centre holes and ream to clear the $\frac{3}{16}$ in. diameter balance staff. Straight grain the sides and burnish all edges, if desired; also drill a 4-B.A. clearance hole at the top for attachment screw.

Assemble the plates to coil, in the following sequence :—

(1) Slide plates over coil until centre holes are more or less coincident with each other.

(2) Insert a slightly tapered $\frac{3}{16}$-in. rod into centre holes, twisting slightly in the meantime, until all holes are lined up.

(3) Cut down to suitable length, the starting end of flexible lead, leaving sufficient to form an eye when clamped under the head of plate securing screw.

(4) Insert screw and clamp both "lead" and plates into position. Remove the $\frac{3}{16}$-in. "tommy bar."

(5) Bind the remaining end of winding along the edge of one plate, and bend at right angles about ½ in. from centre axis. The finished assembly will now look similar to that shown at *D*.

Note—Only resin flux is permissible when soldering these fine wires.

Contact Switch Supporting Column

Turn from nice dark brass, and radius as shown in Fig. 17. File a flat at the upper end for a distance of $\frac{3}{16}$ in., after which the 4-B.A. screw hole can be drilled and tapped. Finish the tapered length to No. "O" emery buffstick, while the radii can be polished to "mirror" finish with "crocus" or "rouge." Make sure, however, before doing this, that every scratch is removed.

Supporting Columns and Finials

Turn from good dark brass or gunmetal, to measurements given in Fig. 18. Polish as

above, with "crocus" and "rouge" for the radii. This will impart an extremely pleasing lustre, which of course, can only be preserved by lacquering, which method will be described later on.

Baseplate

Cut this out from perfectly flat $\frac{1}{8}$-in. sheet brass as in Fig. 19, taking particular care to radius the corners symmetrically. Round all edges and roughly straight grain both surfaces. At this stage only the following holes should be drilled :—

(*a*) The large $\frac{3}{4}$ in. diameter hole, accommodating the fixed electro-magnet.

(*b*) Two 2-B.A. clearance holes pitched at $3\frac{3}{4}$ in., taking the upper shanks of supporting columns.

(*c*) A single 2-B.A. clearance hole $2\frac{3}{8}$ in. offset from centre line, for contact-switch column. this hole should be elongated to allow for adjustment of contact depth.

(*d*) Two 4-B.A. tapped holes offset from front edge by $\frac{3}{8}$ in. and pitched $1\frac{3}{8}$ in., forming the front bearing anchorage.

To attain accuracy in the relative position of components, all further work on this plate must now be held over until all other items have been assembled.

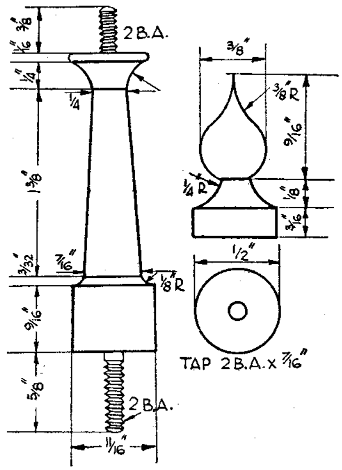


Fig. 18. *Supporting columns and finials*

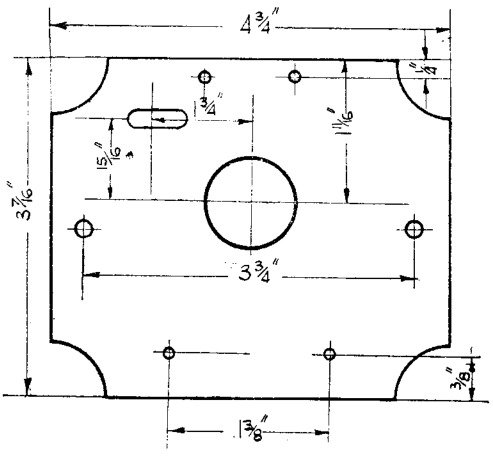


Fig. 19. *Baseplate*

Control Spring Collet and Stud

Drill and turn up control spring collet from $\frac{1}{2}$-in. brass rod, reducing the diameter to a fraction under 13/32 in. Drill and tap two 10-B.A. holes at right angles to each other, and staggered by the distances shown in Fig. 20. File a declivity across the centre screw axis extending tangentially, inwards from the outer circumference to a depth of approximately 0.0165 in. This will give a "flat" of about 5/32 in. on each side of anchorage screws. Leave the bore slightly under size, so that the final fit on staff can be accurately made by reaming. Polish both sides and edges, and fit two polished and blued 10-B.A. cheese-headed screws, making that for the centre with a well rounded head. The remaining screw is for clamping to balance staff, therefore the shank must extend completely through the wall.

Shape up the control spring stud from $\frac{1}{4}$-in. steel bar, making sure that *all* faces are dead square ; make it fit the slot in front pedestal, a nice push fit. File out the slot as square as possible, otherwise the spring will lean over when clamped, which defect is very difficult to rectify, owing to the necessarily heavy gauge of steel ribbon used in its construction.

Drill and tap the 10-B.A. hole accommodating a spring clamping screw. Finish *all* edges and faces to dead polish and fit screw ; the latter containing a nicely blued head.

Control Spring

The control spring must now be fitted to its collet, which job requires a certain amount of skill and should be tackled as follows :—

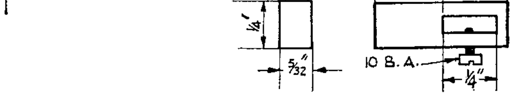


Fig. 20. *Control spring collet and stud*

(1) Bend a short length of the inner turn to a rather abrupt angle as shown in Fig. 20.

(2) Hold the spring *very carefully* by its outer coil and gently *spring* out the centre coil, with finger of left hand, until the anchorage hole is exposed.

(3) Place the collet roughly into position with end of spring abutting the deepest end of declivity.

Holding this rather trying position, insert the 10-B.A. anchorage screw and *lock tightly*.

(4) Release spring which should be perfectly flat, if not, adjust inner turn *only*, until it is so. Fig. 21 gives a general idea of the spring and its measurements.

Fixed Electro-magnet

Machine the core from ¼ in. good quality soft iron, to dimensions shown in Fig. 22. The rectangular pole track shown, can in this case, be screwed and riveted to the core; a

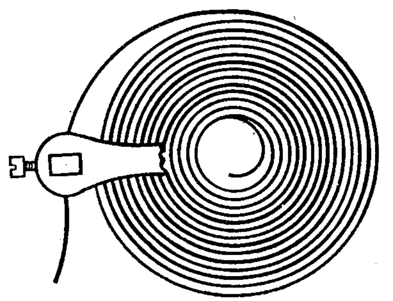


Fig. 21. Control spring. Width of strip, 5mm.; thickness of strip, 0.013 in.; length of ribbon about 5 ft.; No. of coils (wound), 16; approximate diameter, 2½ in.; diameter of centre opening, ½ in.

suitable spigot must therefore be provided and threaded 2 B.A. for this purpose. The two insulated flanges can be turned to size, and finished after forcing into position. "Sweep" the 17/32 in. radius, after assembly, but before winding, preferably by grinding, in which case the job can be held in slide rest by its 2-B.A. anchorage shank.

Proceed to wind as already described for the balance coil; do not, however, completely fill the bobbin, but leave about the equivalent of two layers from flange circumference, to clear the starting and finishing ends.

Bend up and finish the carrying bridge from $\frac{1}{16}$-in. brass strip, drilling a centre 2 B.A. clearance hole for the coil anchorage, and two 4 B.A. clearance holes for attachment to baseplate. The "pitch" of these is shown on drawing. Mount the coil in its bracket and secure tightly, with one nicely finished 2-B.A. brass nut. The appearance should now be similar to that shown on the drawing.

Finishing the Parts

From time to time the expression, "burnish all edges" has cropped up in the text. Just what this means is that edges of plates and other parts are brought to a mirror finish, by a process of rubbing the surface of a fairly soft metal, by one of highly polished hardened steel. But first the surface to be burnished must present a finish, brought about by buffstick, etc., in which every scratch has been removed.

The actual burnishers can be very easily made by any amateur from discarded files; the types required being round and half round for finishing edges, and flat for surfaces of small area. First soften the files and allow to slowly cool, preferably by immersing in coke ashes. After which :—

(1) File or grind off all cutting edges, and finally polish the surfaces to about No. "O" carborundum.

(2) Reharden by direct plunging in water, and again polish.

For finishing the surface of plates, a medium grain is generally given, which simply means that a buffstick of medium grade, say about No. "1½" carborundum or emery, is used for finishing, by working over the surface in straight strokes from end to end and parallel to edge of plate.

To attain a very pleasing effect on medium and large areas, such as the baseplate, frontplate, etc., the finished surface can be either "snailed," or "feathered," the former being the simplest to perform.

For "snailing" proceed as follows :—

(*a*) Mount a short length of fine grade carborundum stick, in a piece of copper tube, allowing about ⅛ in. to project. Mount in the lathe or drilling machine, chucking as true as possible.

(*b*) Run at fairly high speed and lightly touch the surface of plate, moving it diagonally, slowly, from corner to corner, at the same time imparting a circular movement. Do not make the scroll continuous, but break it up, and apply a "criss-cross" method; this will make the result more attractive than ever.

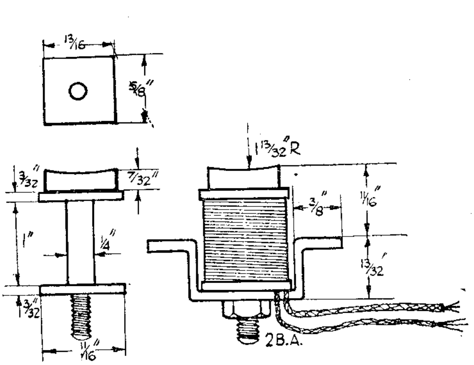


Fig. 22. Details of fixed coil and bracket

The second system is more difficult to apply, and necessitates an absolute flat surface otherwise the markings will not be uniform. In this case the process consists of "waving" or "feathering" the plate surface diagonally but symmetrically from corner to corner, by means of a revolving emery, or carborundum stick, run at fairly high speed. It is necessary when doing this to advance the plate in even steps, so that the apex formed from each pair of "sweeps" assume an almost straight line.

There are also several other methods of enhancing the surface, such as "spotting," where symmetrical spots are formed diagonally across the surface by a fast running carborundum stick.

(*To be continued*)

PRACTICAL LETTERS

Mill Engines

DEAR SIR,—I was recently able to visit Mr. Cragg, at Roy Mill, Royton, Lancs, as a result of the letter which appeared in the issue of THE MODEL ENGINEER of April 7th, 1949, and I feel bound to let you know how much I enjoyed Mr. Cragg's hospitality. I arrived early in the afternoon and was very soon in the privileged inner sanctum of the engine house.

This great edifice was very well kept and its green ceramic tiles of about 9 in. square were fixed up to a height of 10 ft. or so all round the engine house, and were obviously cleaned down regularly. Some of the engine house floor was boarded, but near the engine itself there was an extensive use of cast-iron chequered plate.

The engine, by Buckley & Taylor, Oldham, is a twin tandem compound, with slide valve low-pressure cylinders of 46-in. bore, nearest to the crankshaft and mounted in line, and behind these are the 21¼-in. diam. high-pressure cylinders which use a piston rod common to low- and high-pressure pistons. No tail-rod extends out of rear H.P. cylinder covers, but provision for supporting the very considerable weight of such large pistons and rods is made by placing a casting between the two cylinders. On this casting is a very long half-bearing, of considerable area (white-metal lined), and supporting the underside of the piston rods, which slide freely over them. This bearing does not interfere with the accessibility of the H.P. gland, nor L.P. tail-gland, of which it is entirely independent.

The H.P. valve-gear is very interesting and is basically of "Corliss" principle, with four valves per cylinder. I was informed that the dashpot cylinders were not in communication with the condenser, but spring action only is used to close the valves.

At the great main bearing on the right-hand side of the crankshaft is a bevel reduction gear driving at 2-1 up a longitudinal shaft, parallel to the line of motion. This shaft terminates between the two right-hand side cylinders, at which point another bevel reduction gear drives, at 2-1 back to engine speed, a cross-shaft parallel to the crankshaft. This shaft extends across to the left-hand engine, and at each end it carries a pair of eccentric sheaves. To these are connected the separate admission and exhaust eccentric-rods which operate the valves of the right-hand and left-hand high-pressure cylinders. Although four eccentrics are used on the H.P. valves, there are only the usual two eccentrics for the low-pressure valves, one fixed on the crankshaft near the right-hand pedestal and the other near the left-hand pedestal bearing.

On each side of the engine, driven by the hefty right-hand and left-hand crossheads respectively, are a pair of balanced air pumps and dual boiler feed pumps which, due to the design, operate very smoothly indeed.

Pump lubrication is provided by two gear-type centrifugal pumps, drawing oil from a tank beneath the engine bed, and a very neat system of cowling round the crank throws and big-ends, etc., causes the oil to return, without loss, to a filter from where it passes to the main tank and is re-used.

Mechanical pumps deliver cylinder oil through large sight-feeds.

Between 1,600 and 1,800 h.p. only was being used when I inspected the engine, but over 2,000 h.p. is possible, and occasionally called for.

If readers can imagine themselves sitting in the engineer's chair surveying this fine engine at work with never a bang, thump nor thud, nor a wisp of leaking steam anywhere, but 60 tons of flywheel —24 ft. diam. of it—silently paying out all that power into its 44 ropes, and only the merry cut-off click of the admission valves to disturb the peace and tranquility of the engine house, then they will understand the pleasure derived from all this by one who loves all mechanisms in general, from a water wheel to a Merlin aero engine—but steam engines in particular.

In conclusion, may I say how much I enjoy THE MODEL ENGINEER, also that the amount of traction engine information of the past year has exceeded my wildest dreams, and such subject matter to me—with apologies to Cherry Blossom— "There's nothing like it."

Yours faithfully,

Blackpool. ARTHUR WEDGWOOD.

An Unconventional Centre Engine

DEAR SIR,—I was very interested to read your "Smoke Ring" in a recent issue under the above heading.

Charles Heal & Sons, amusement caterers, of this town, had a very fine four-abreast roundabout, with horses, bears, ostriches, twisted brass columns, mirrors, etc. This outfit was in evidence at the biggest fetes and so on when I remember it best—in the early twenties. The centre engine was very like the "M.E." Overtype design, and if I remember rightly, was carried on a dropped platform at the rear of the truck carrying the pivot. The engine had a lot of brasswork about it, including a dummy brass funnel—something like that on an old-fashioned fire engine. The real flue was brought out from the side of the smokebox and taken away to the centre pivot. I am almost certain, furthermore, that this engine carried the nameplate, "General Buller." Certainly, one of Heal's engines was so named. I feel there must be some connection between this outfit and the one you mention. Perhaps some other reader can fill in the gaps.

I also remember a very nicely turned out traction engine of rather small size, which I believe was by Steevens, of Basingstoke. This engine was reputed to have been salvaged from a W.D. dump, in derelict condition, after the 1914-18 war. If this were true, she was certainly splendidly renovated. She carried the name "Little Jimmy the Showman."

Yours faithfully,

Bristol. G. B. DENTY.